(12) UK Patent Application (19) GB (11) 2 395 210 (13) A

(43) Date of A Publication 19.05.2004

(21) Application No: 0326054.4

(22) Date of Filing: 07.11.2003

(30) Priority Data:
(31) 60424455 (32) 07.11.2002 (33) US

(71) Applicant(s):
Weatherford/Lamb Inc.
(Incorporated in USA - Delaware)
515 Post Oak Boulevard, Suite 600,
Houston, Texas 77027,
United States of America

(72) Inventor(s):
Clayton Plucheck
Pat Williamson
David M Haugen
Doug Durst

(74) Agent and/or Address for Service:
Cruikshank & Fairweather
19 Royal Exchange Square, GLASGOW,
G1 3AE, United Kingdom

(51) INT CL[7]:
E21B 43/08 41/00

(52) UK CL (Edition W):
E1F FAB FJF

(56) Documents Cited:
GB 2357099 A **EP 0819823 A3**

(58) Field of Search:
UK CL (Edition W) **E1F**
INT CL[7] **E21B**
Other: **Online: WPI, EPODOC, JAPIO**

(54) Abstract Title: **Wellbore junction liner**

(57) A wellbore junction 300 is completed by a junction liner 120, 250 comprising a tubular body having three openings for fluid communication therethrough, and perforations in a wall thereof. The perforations act as a screen for filtering solid particulate matter but allows passage of hydrocarbons. Also disclosed are an expandable junction liner, and methods for forming and supporting a lateral wellbore. The expandable junction liner may be used to support the junction.

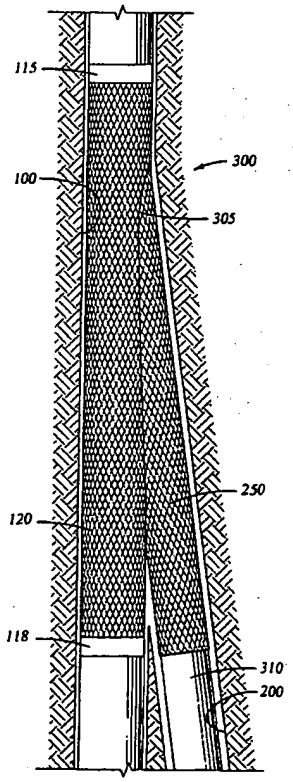

Fig. 13

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

GB 2 395 210 A

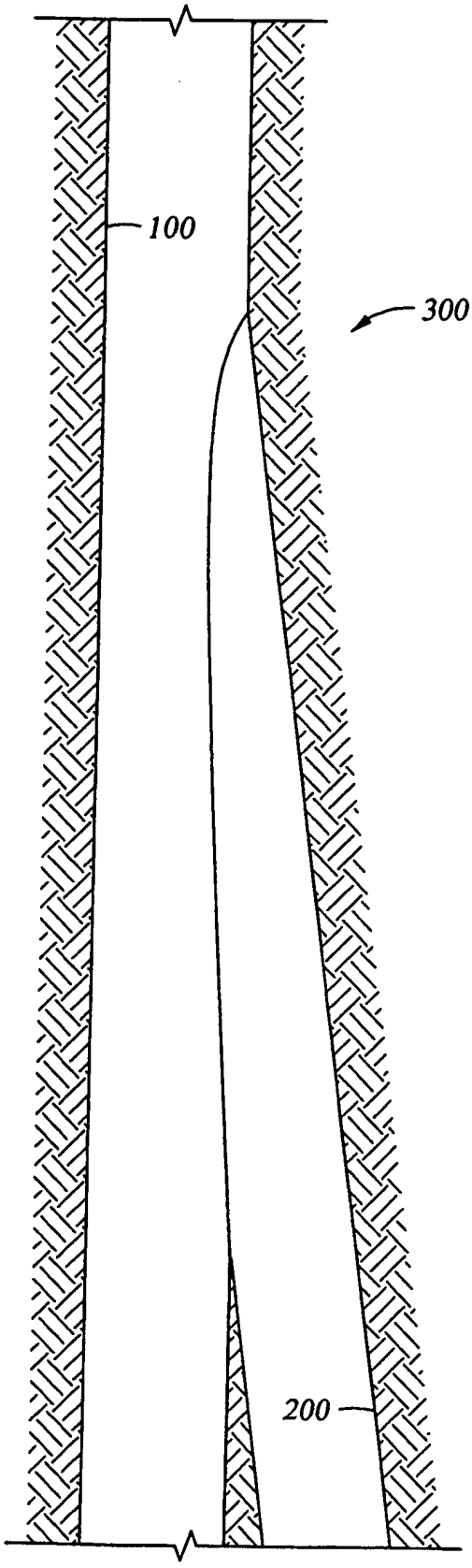

Fig. 1

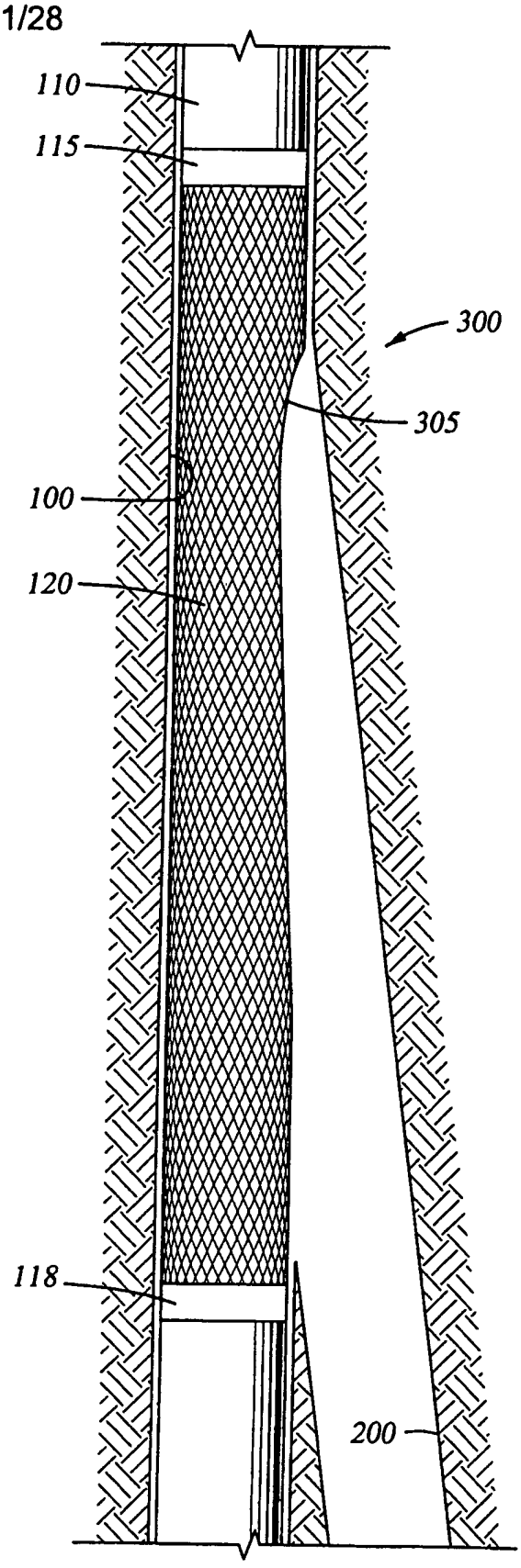

Fig. 2

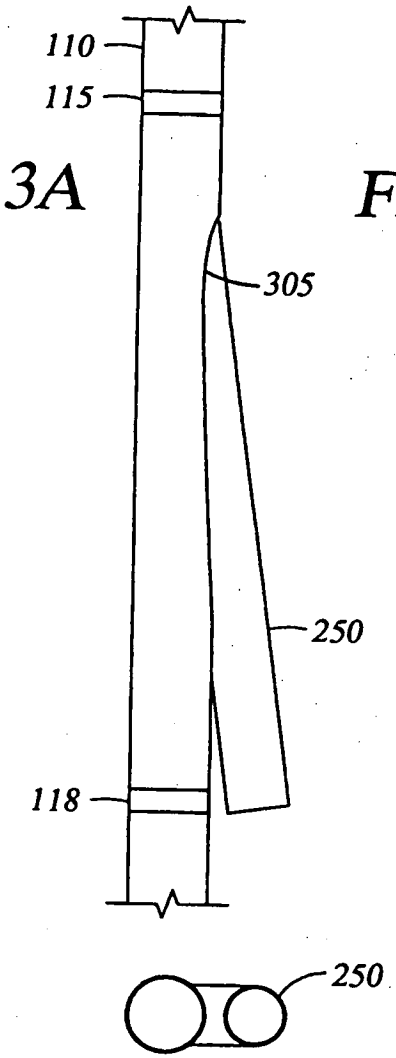

Fig. 3A

Fig. 3B

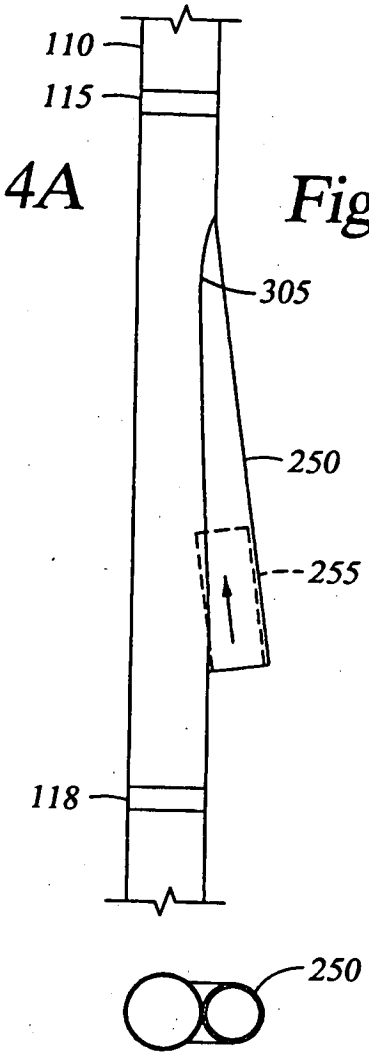

Fig. 4A

Fig. 4B

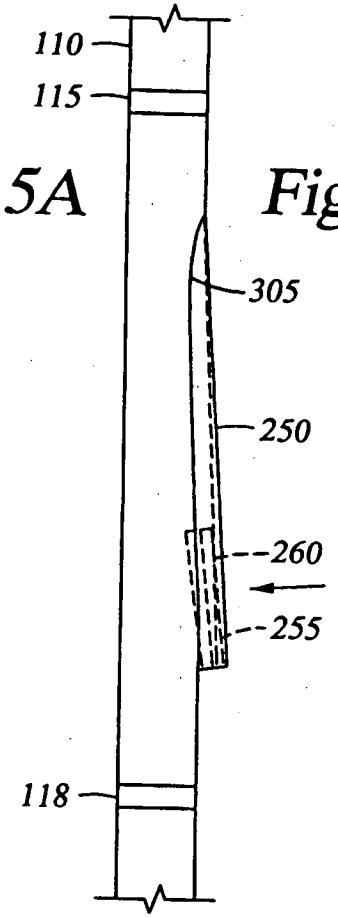

Fig. 5A

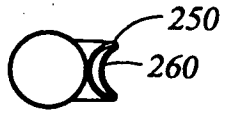

Fig. 5B

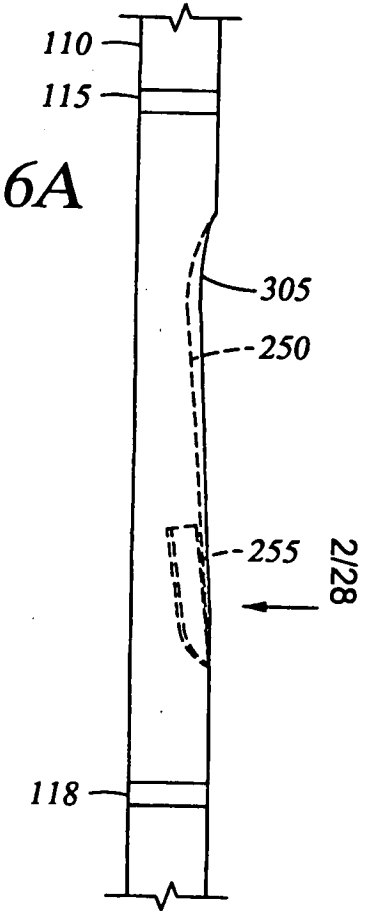

Fig. 6A

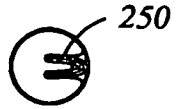

Fig. 6B

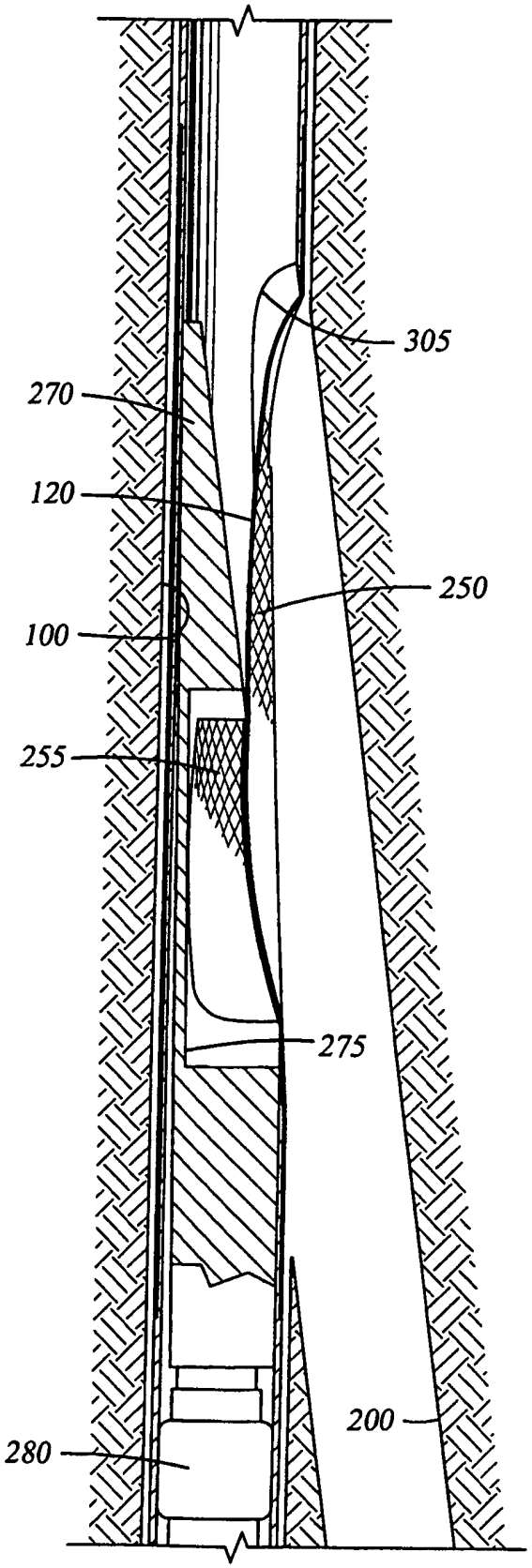
305
270
120
250
100
255
275
200
280

Fig. 7

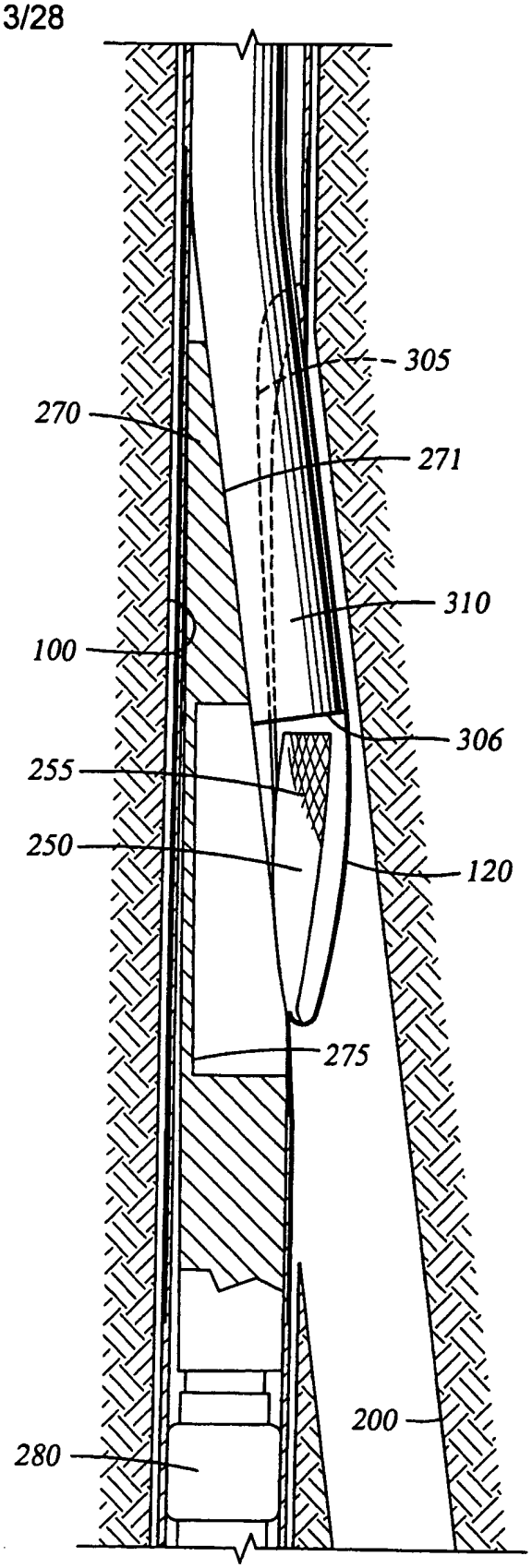
305
270
271
310
100
306
255
250
120
275
200
280

Fig. 8

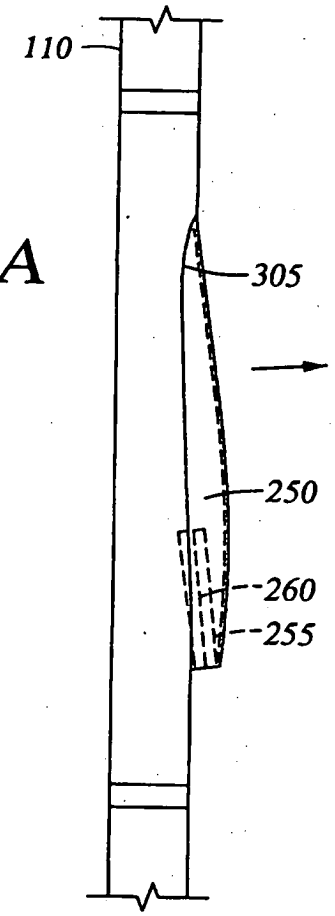

Fig. 9A

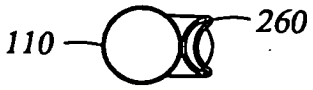

Fig. 9B

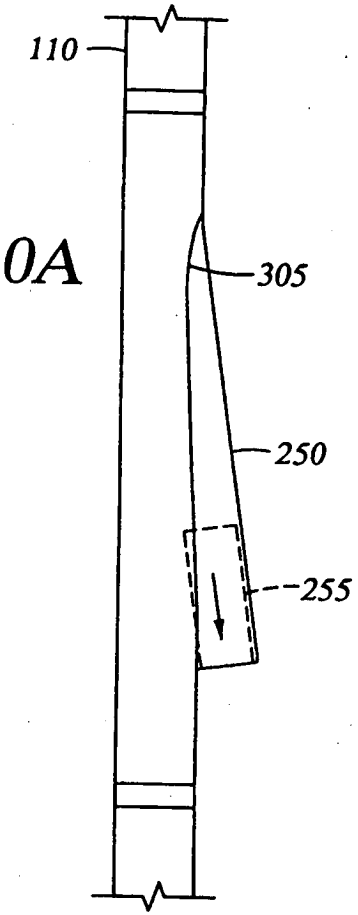

Fig. 10A

Fig. 10B

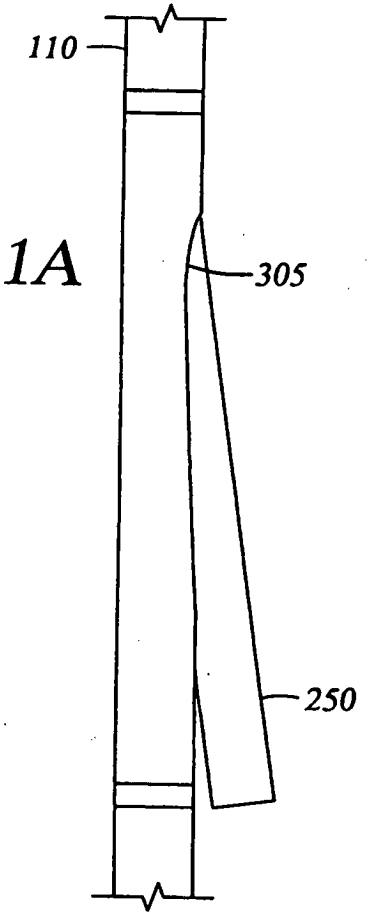

Fig. 11A

Fig. 11B

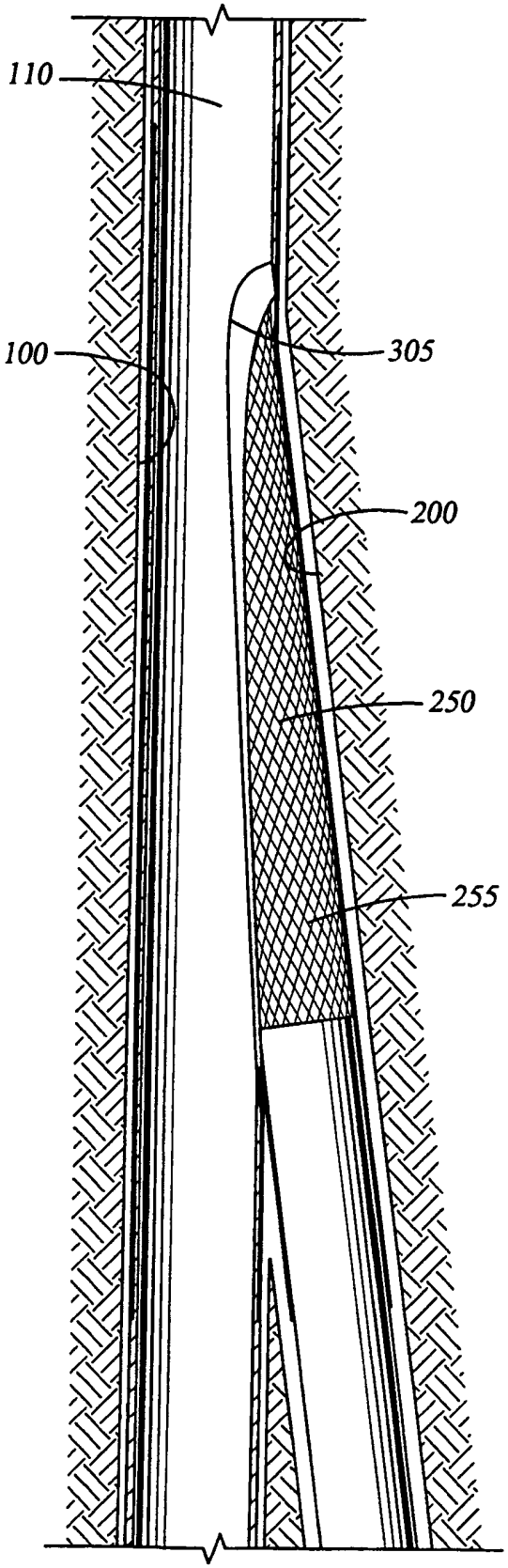

Fig. 12

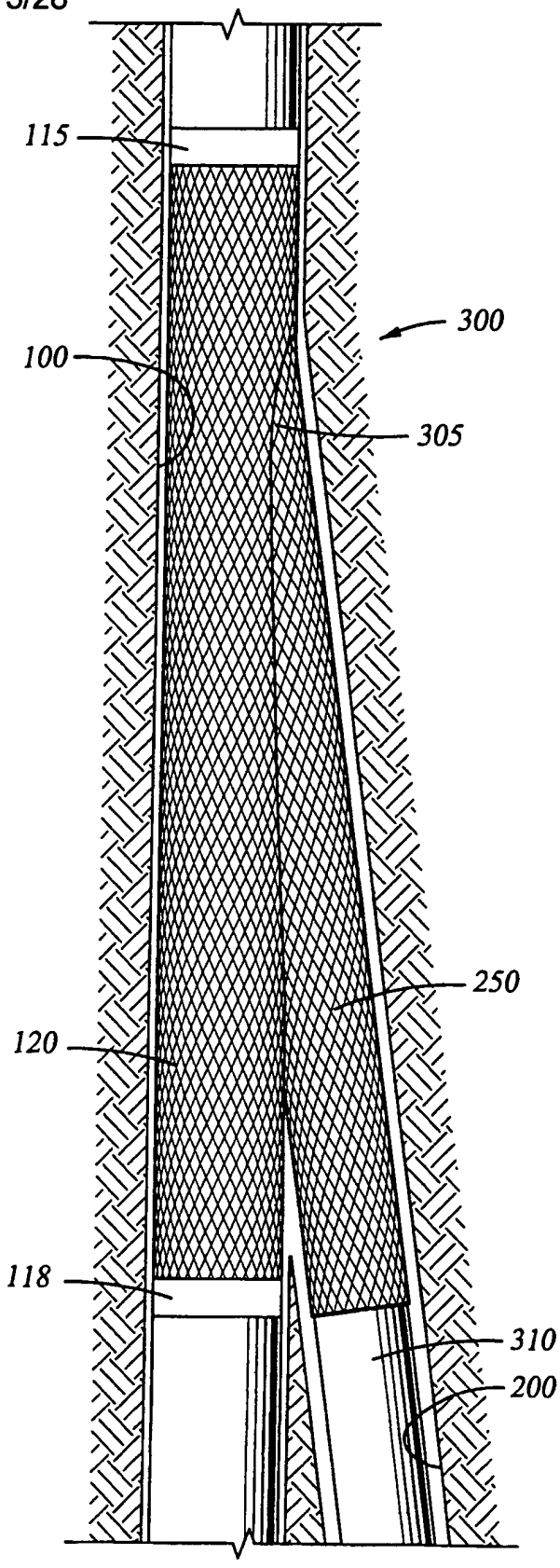

Fig. 13

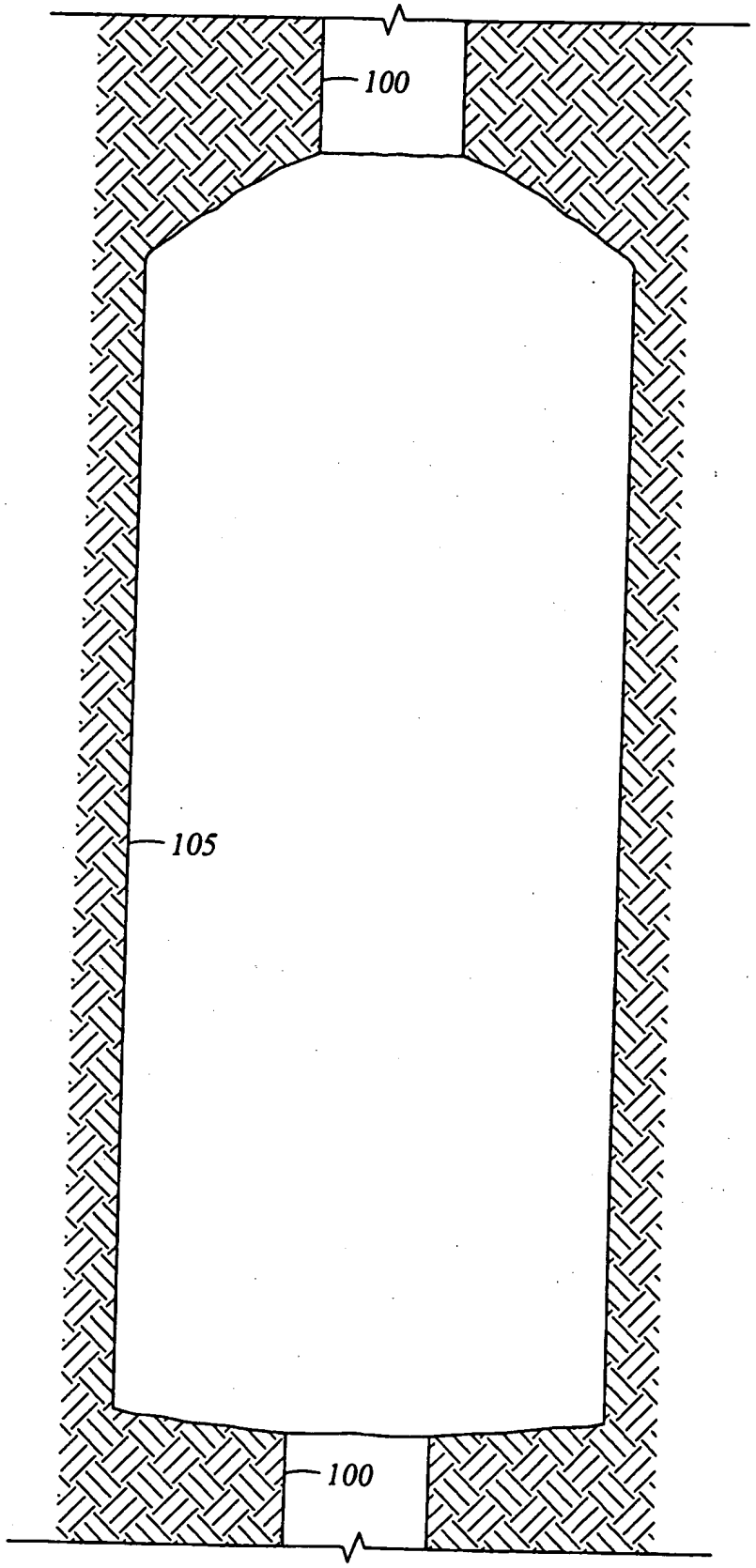

Fig. 14

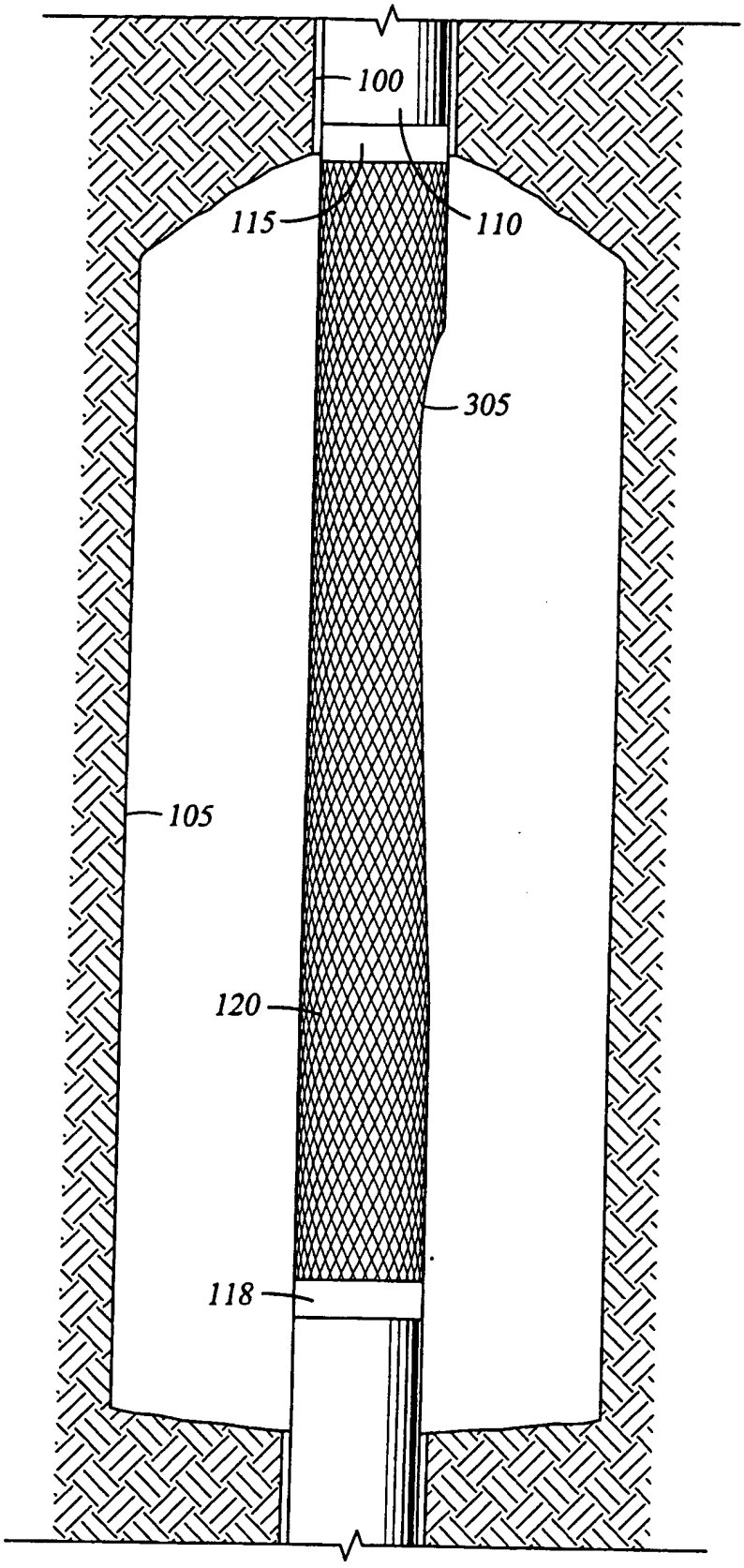

Fig. 15

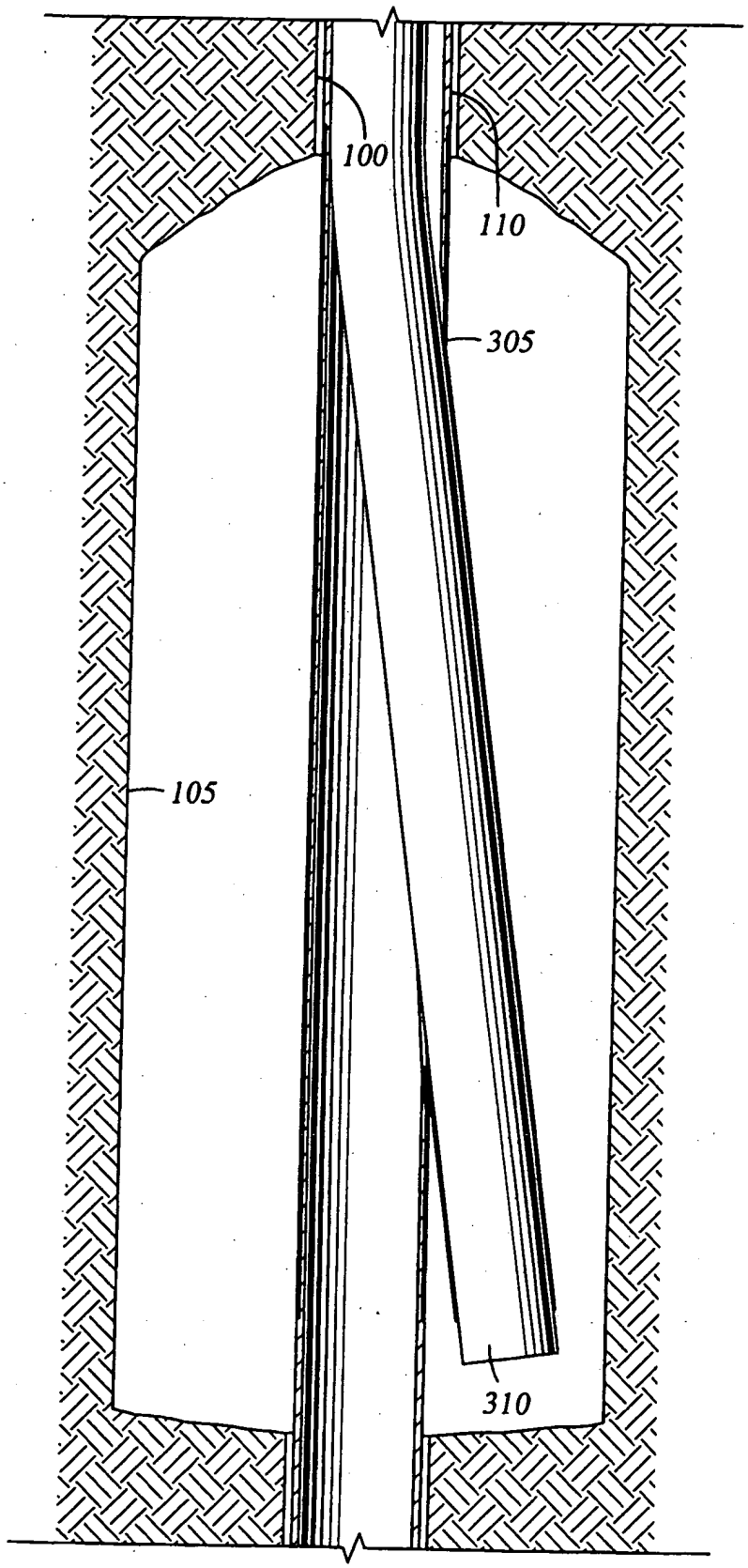

Fig. 16

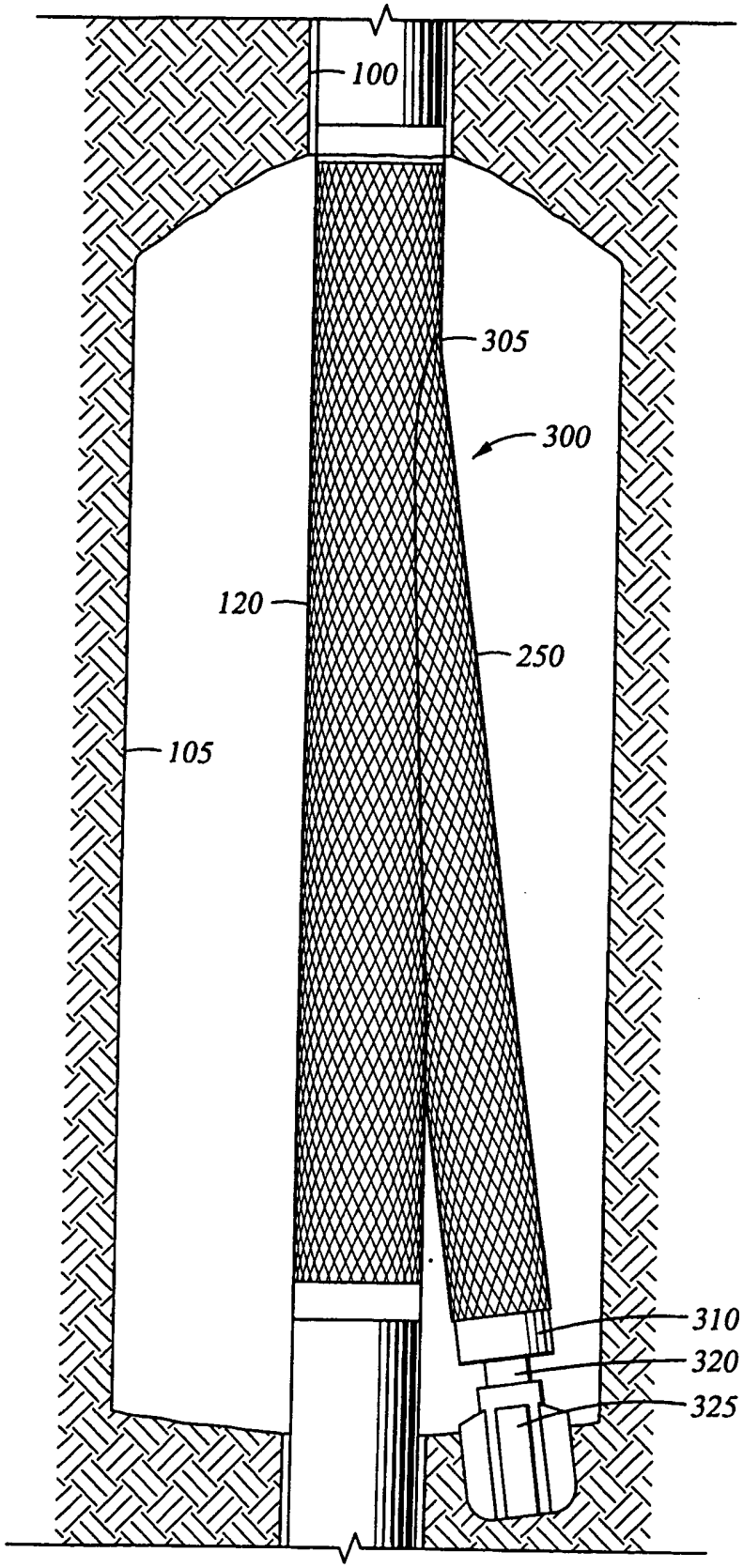

Fig. 17

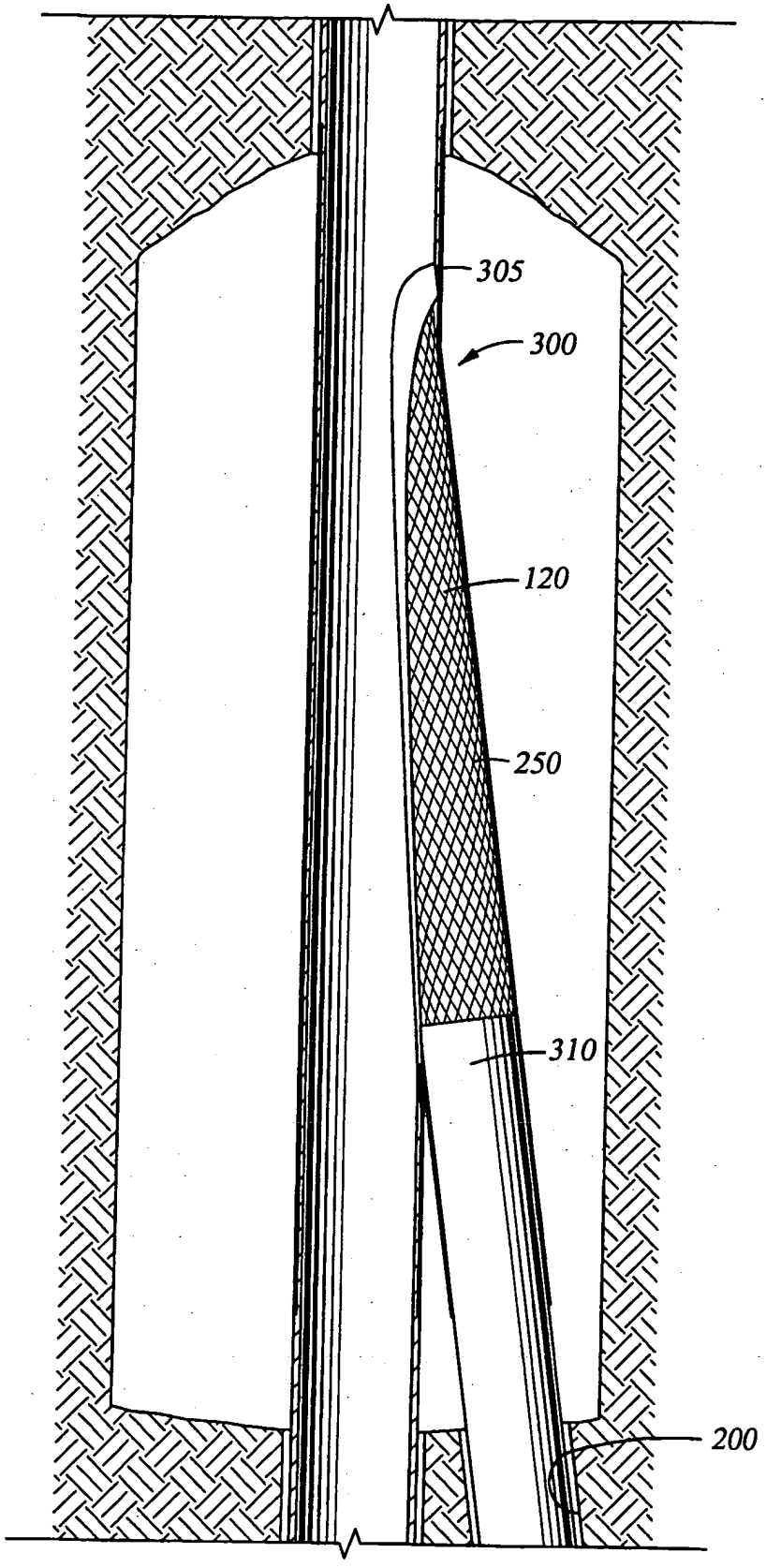

Fig. 18

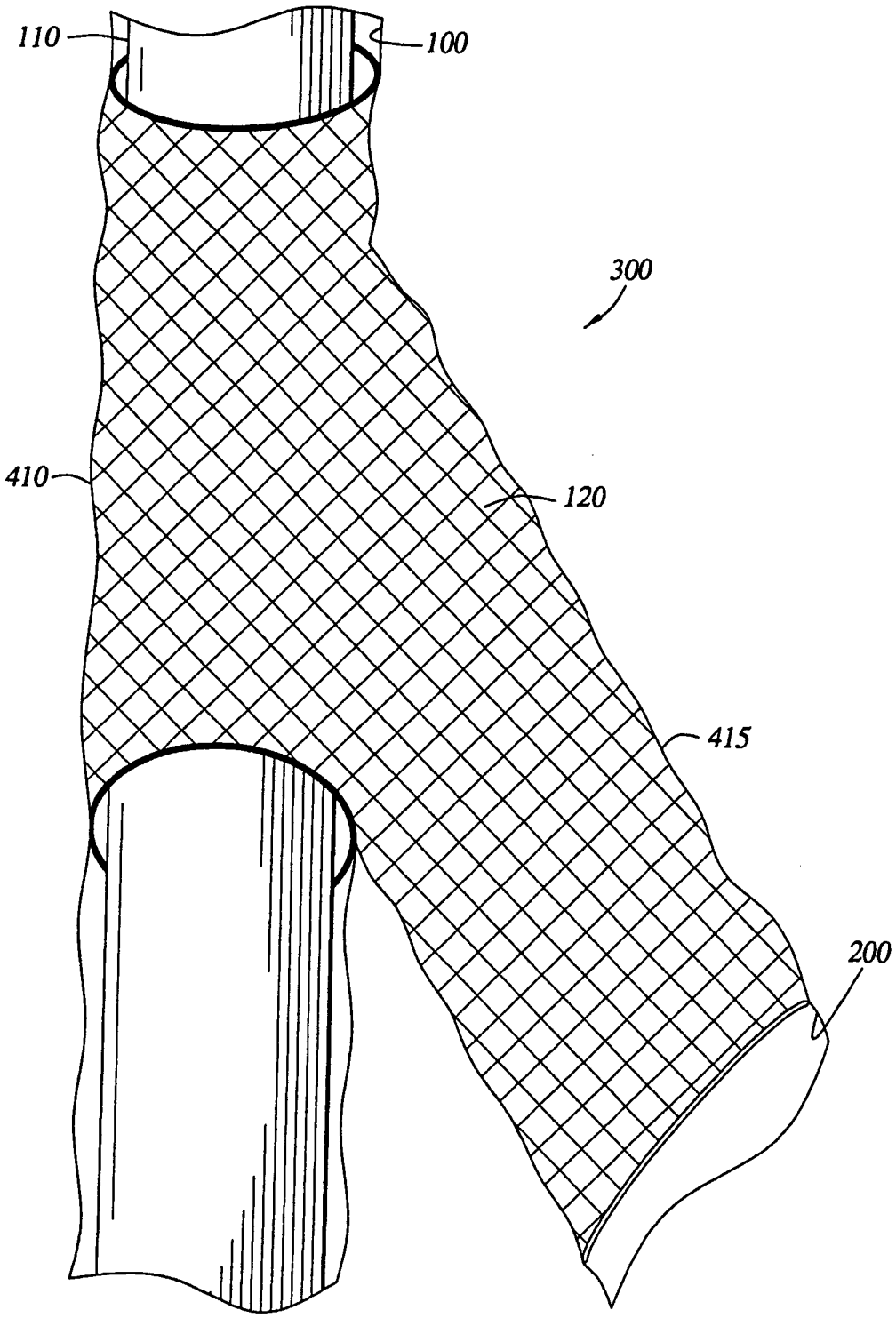

Fig. 19

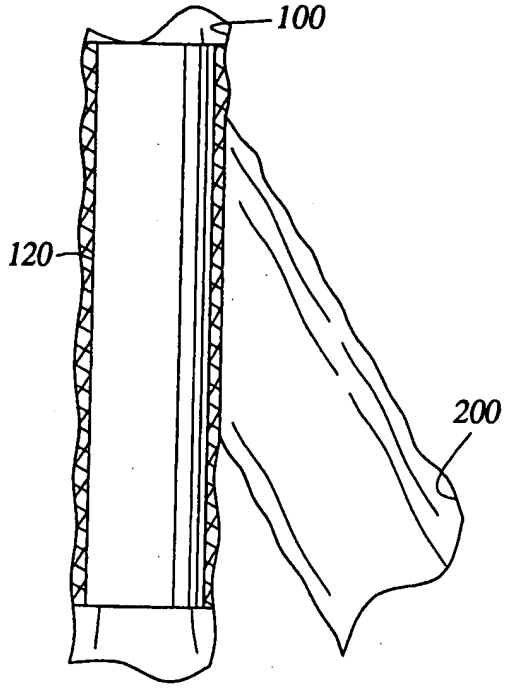

Fig. 20A

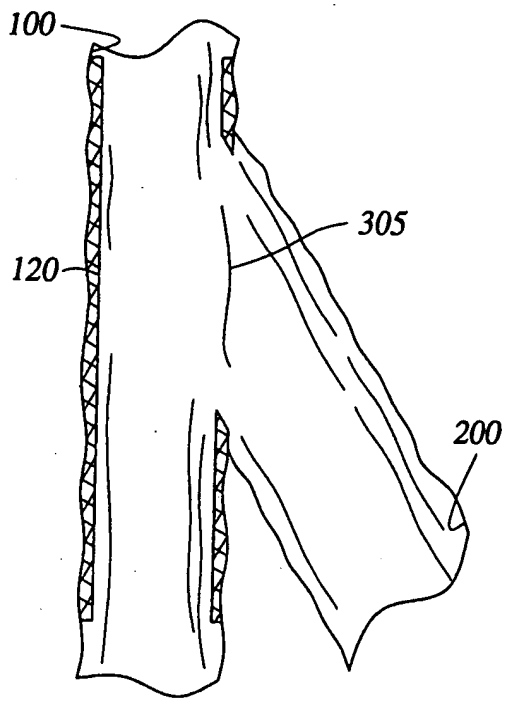

Fig. 20B

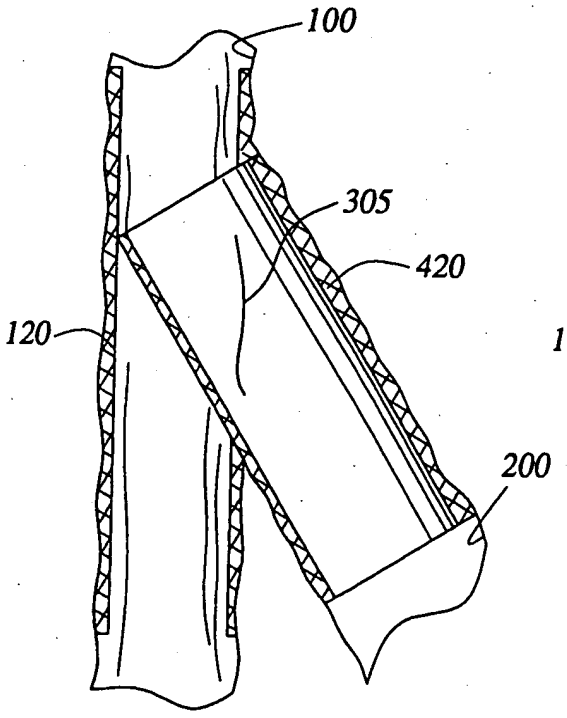

Fig. 20C

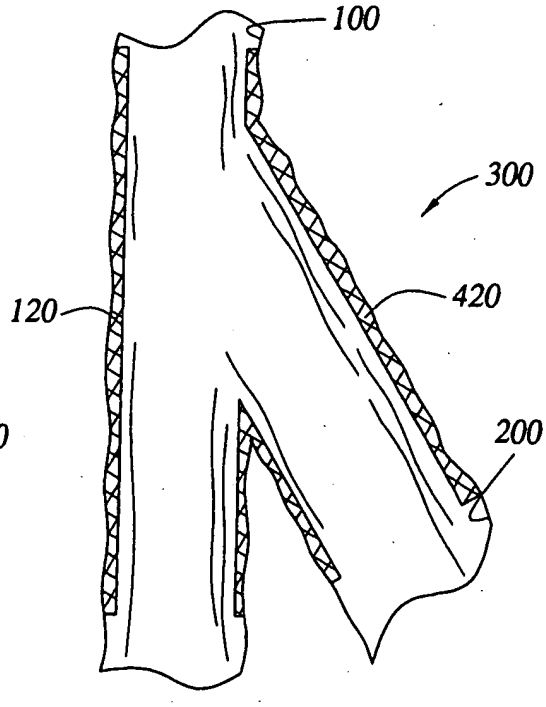

Fig. 20D

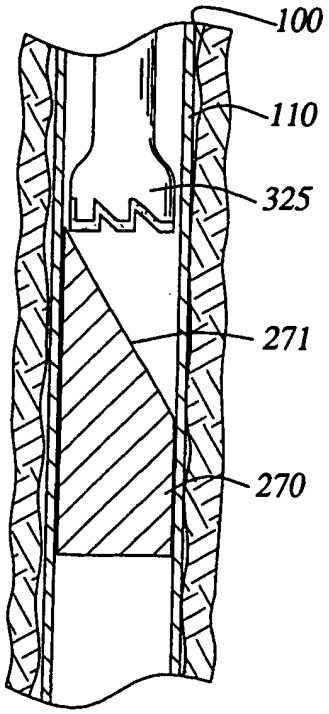

Fig. 21A

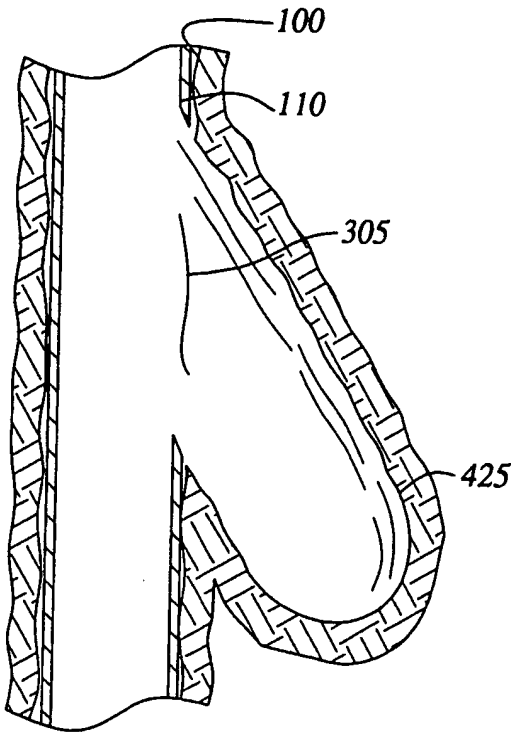

Fig. 21B

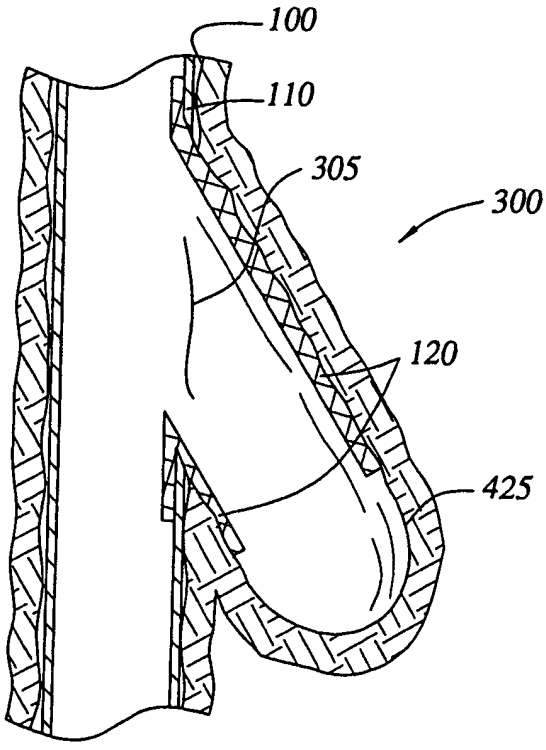

Fig. 21C

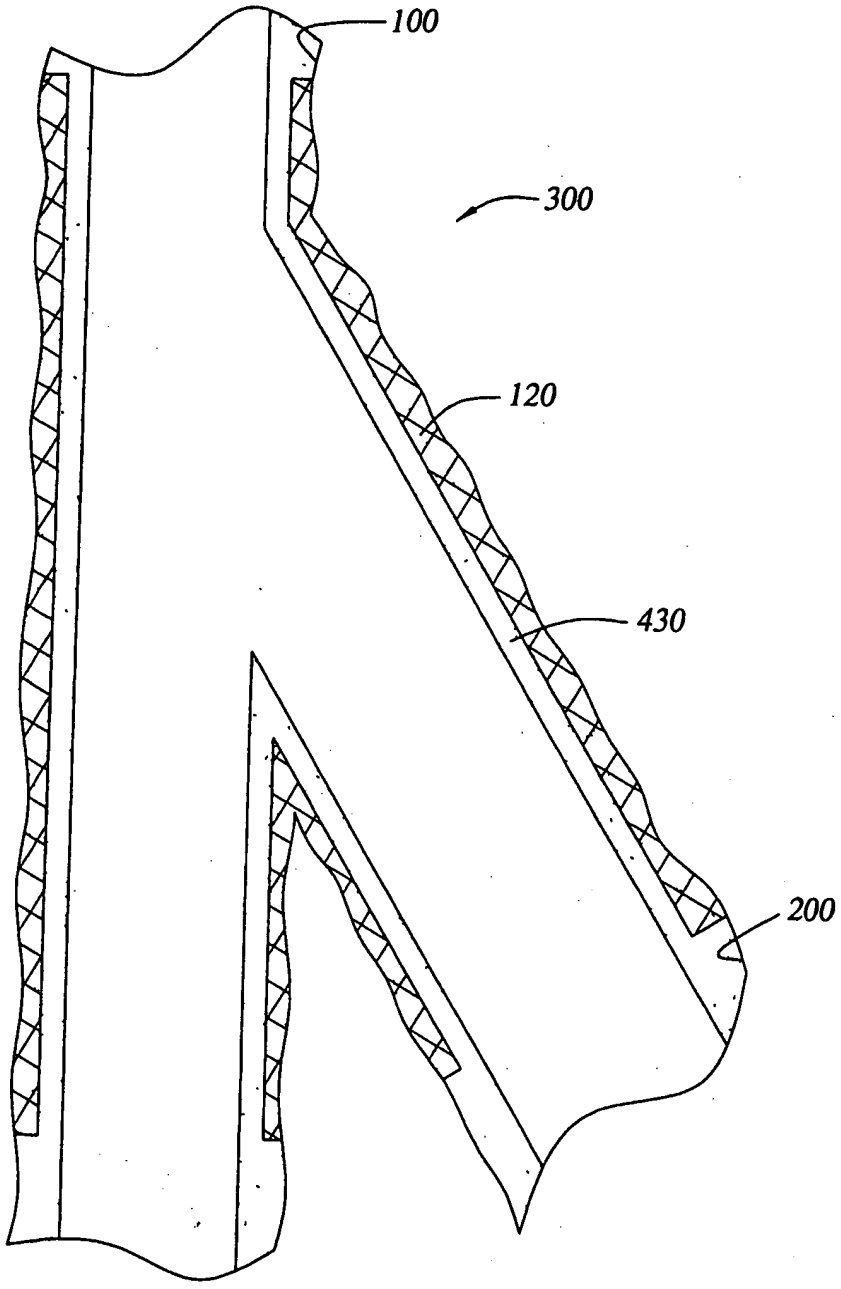

Fig. 22

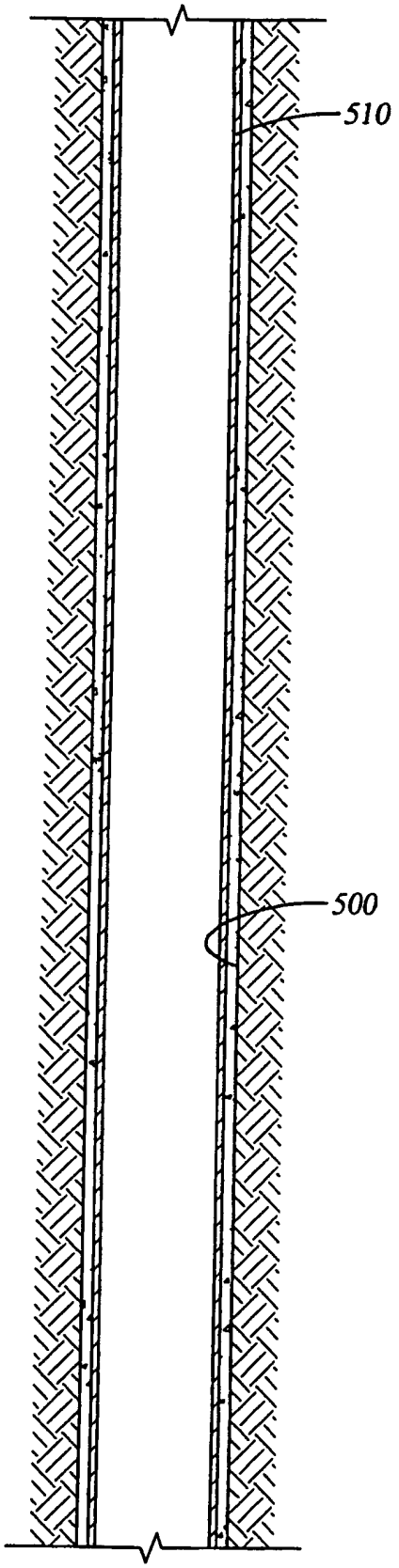

Fig. 23

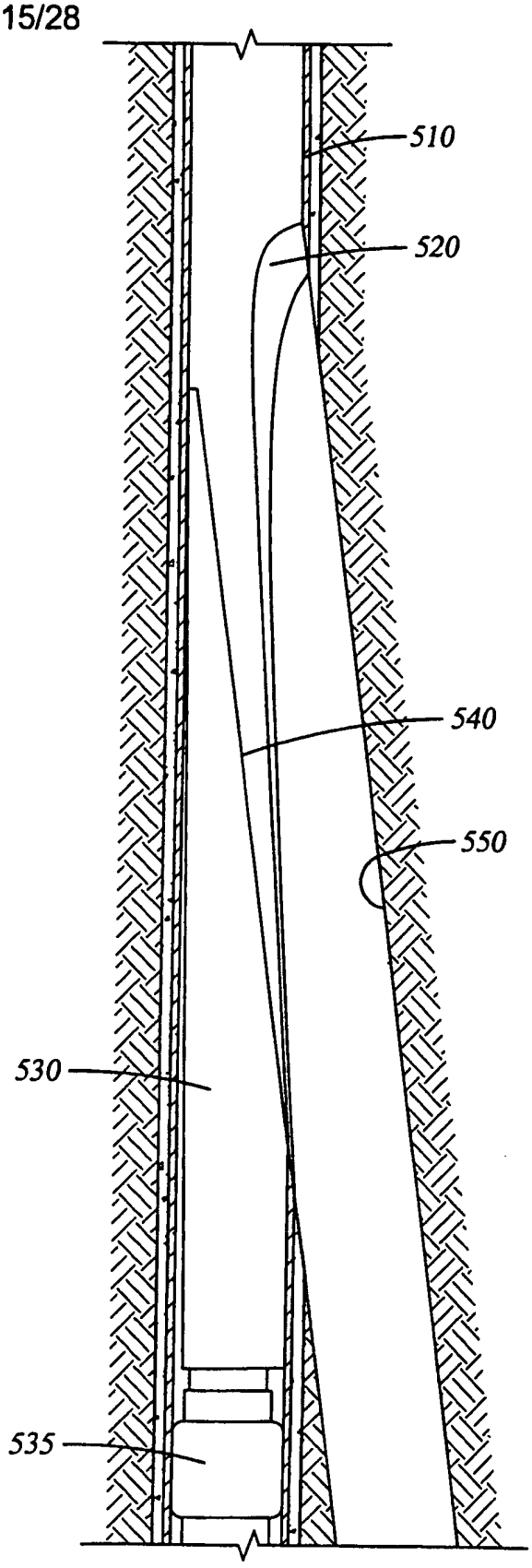

Fig. 24

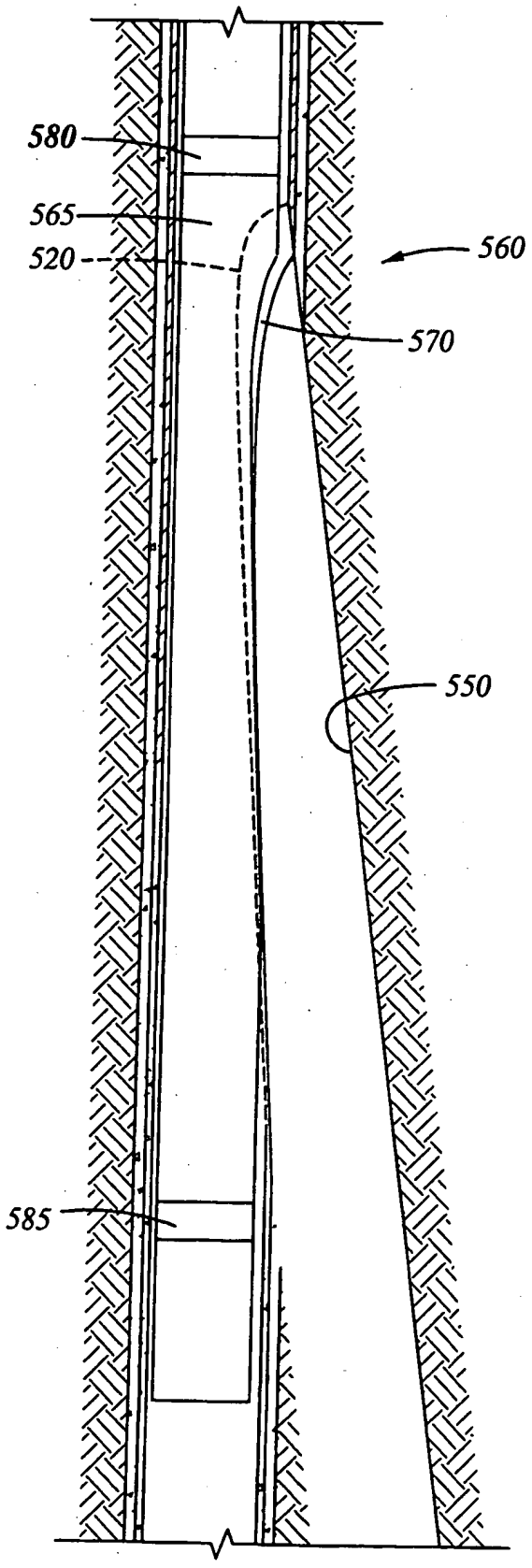
580
565
520
560
570
550
585

Fig. 25

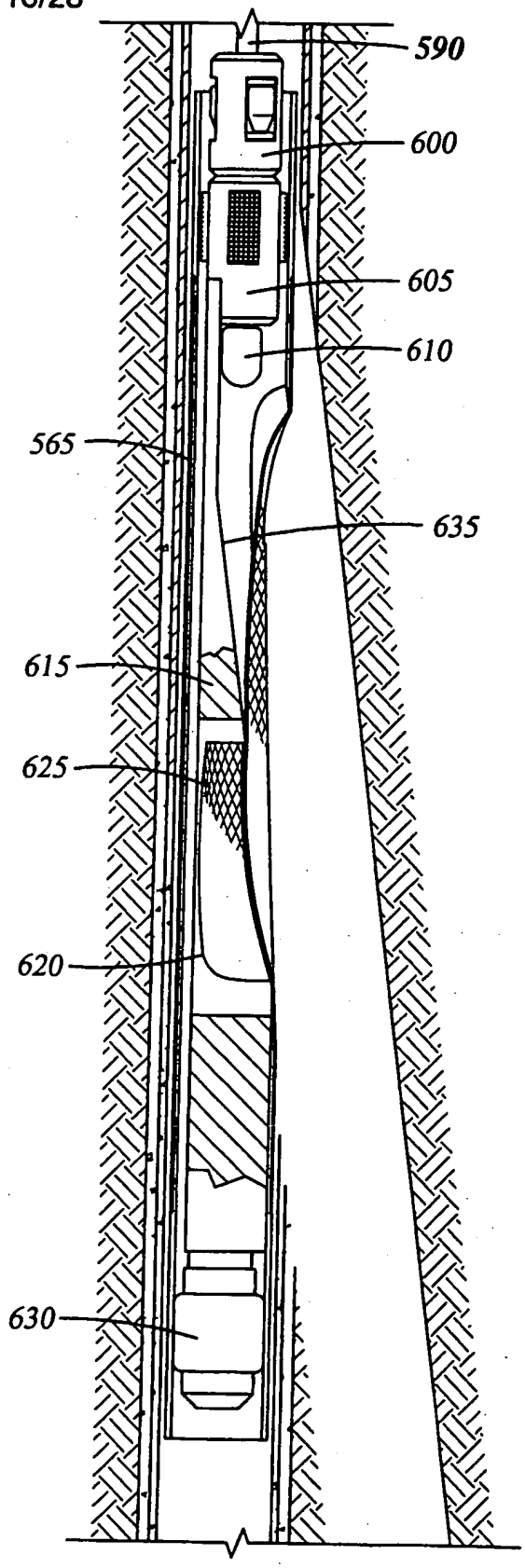
590
600
605
610
565
635
615
625
620
630

Fig. 26

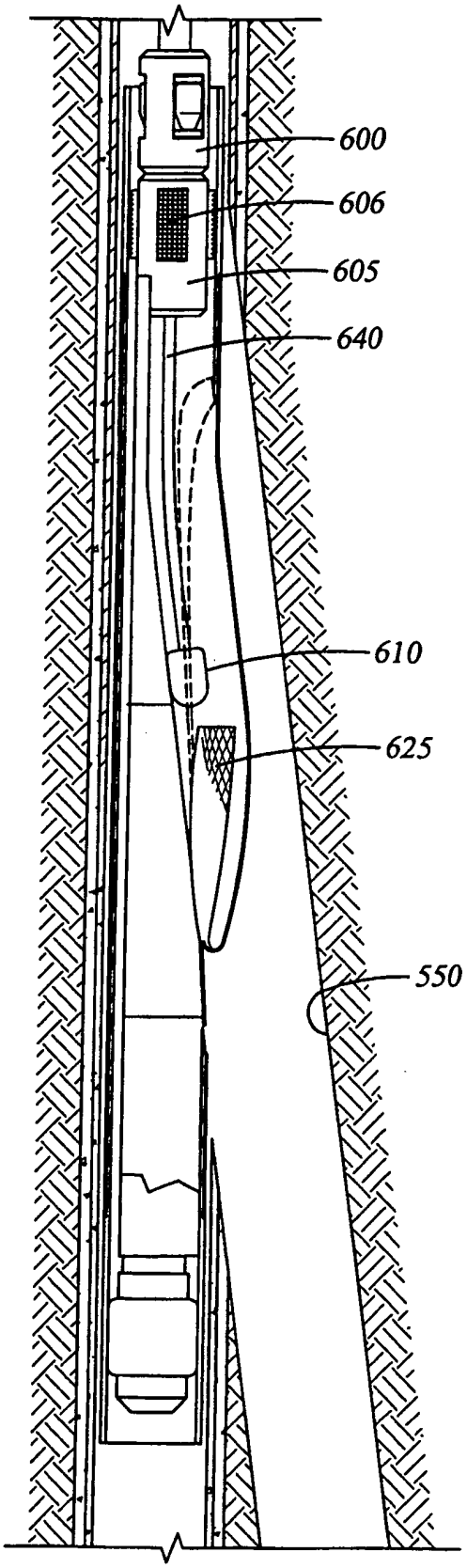

Fig. 27

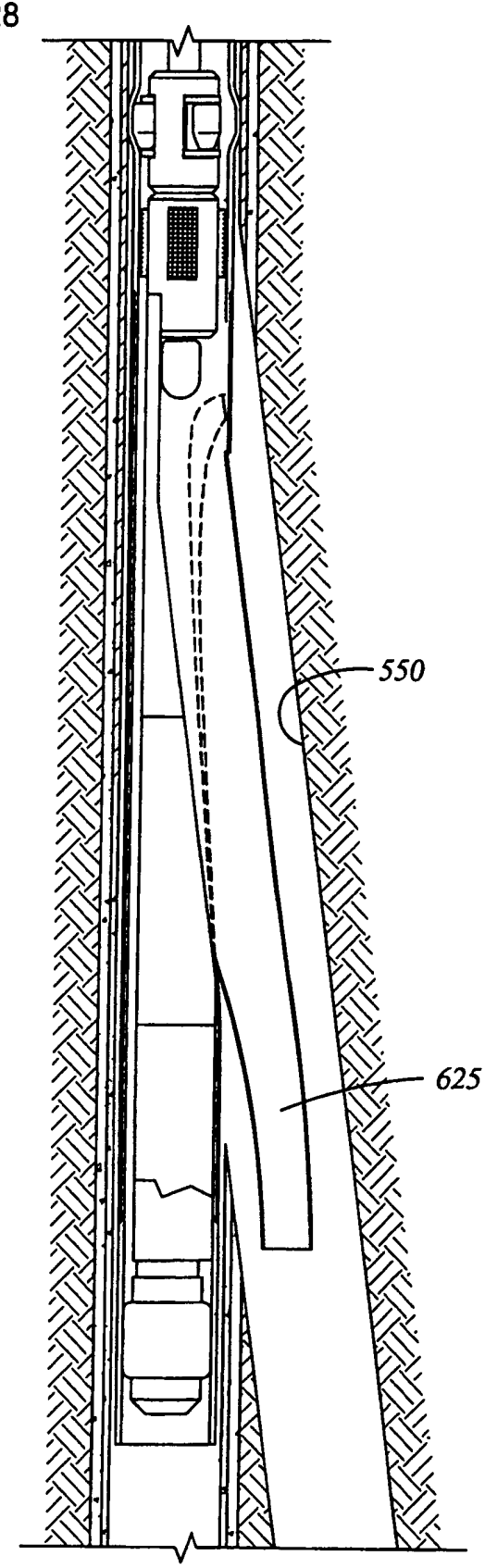

Fig. 28

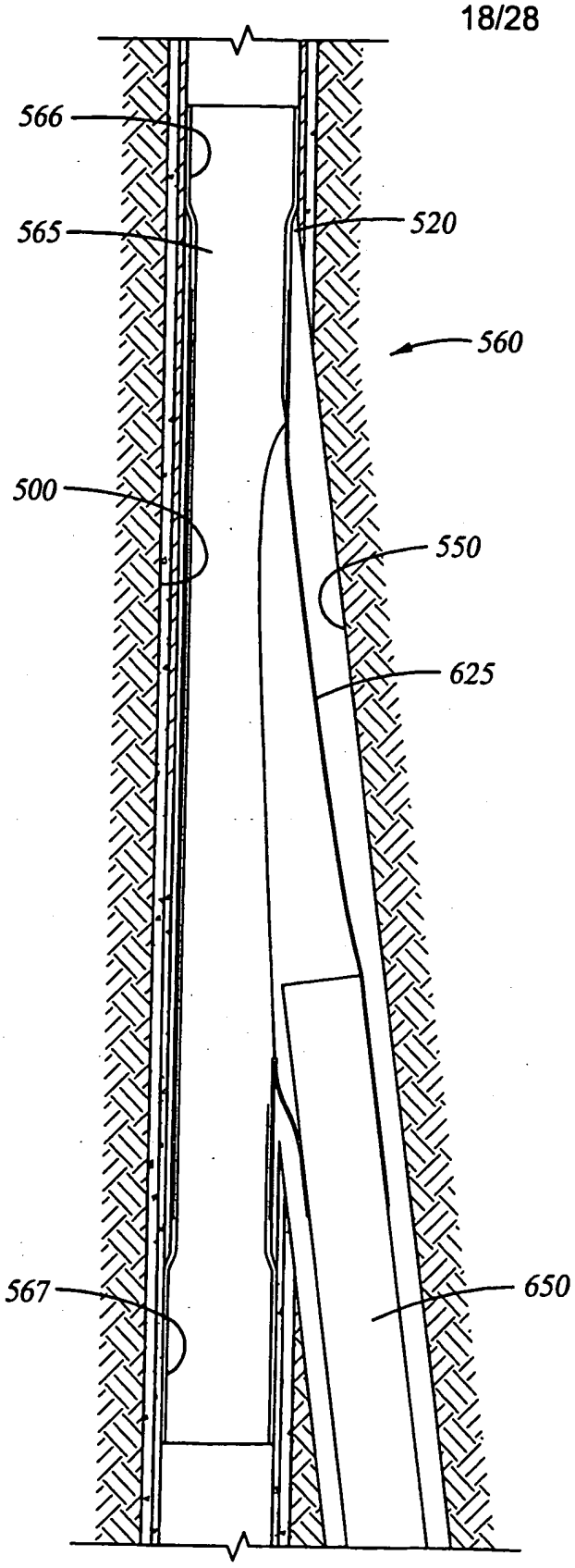

Fig. 29

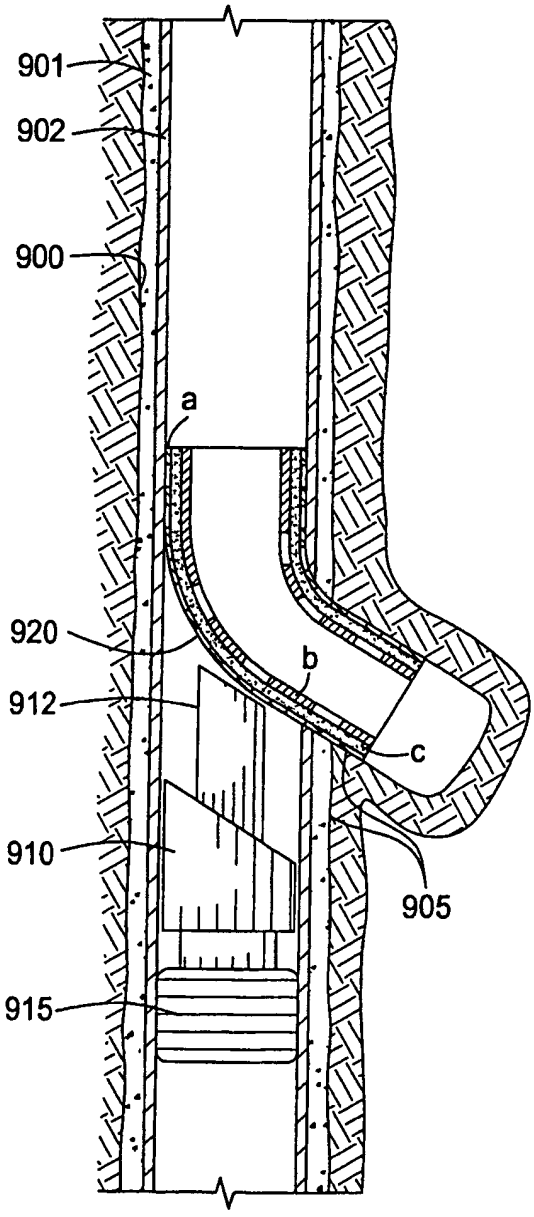

FIG. 30A

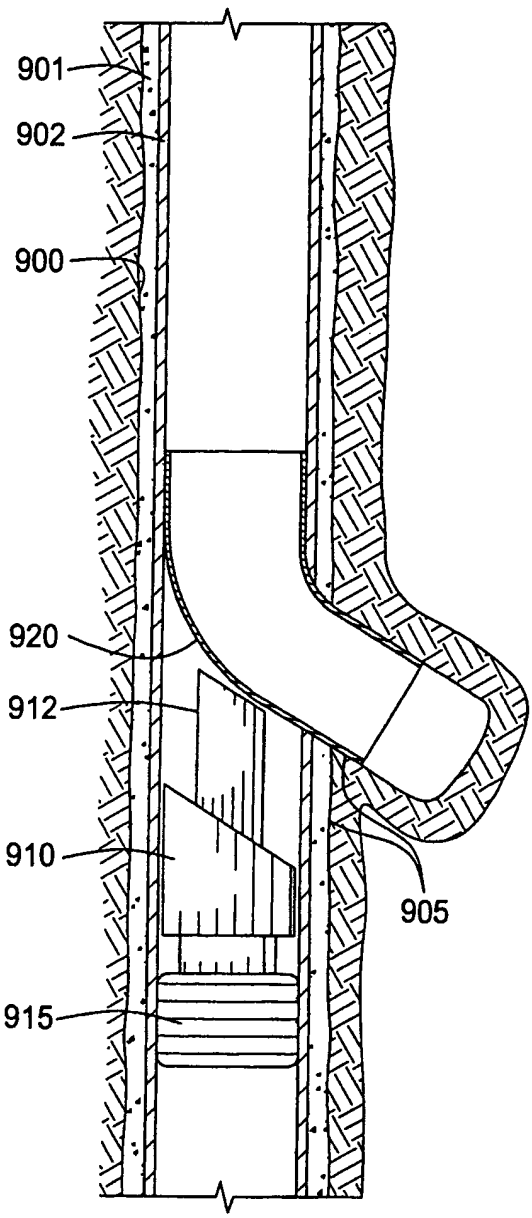

FIG. 30B

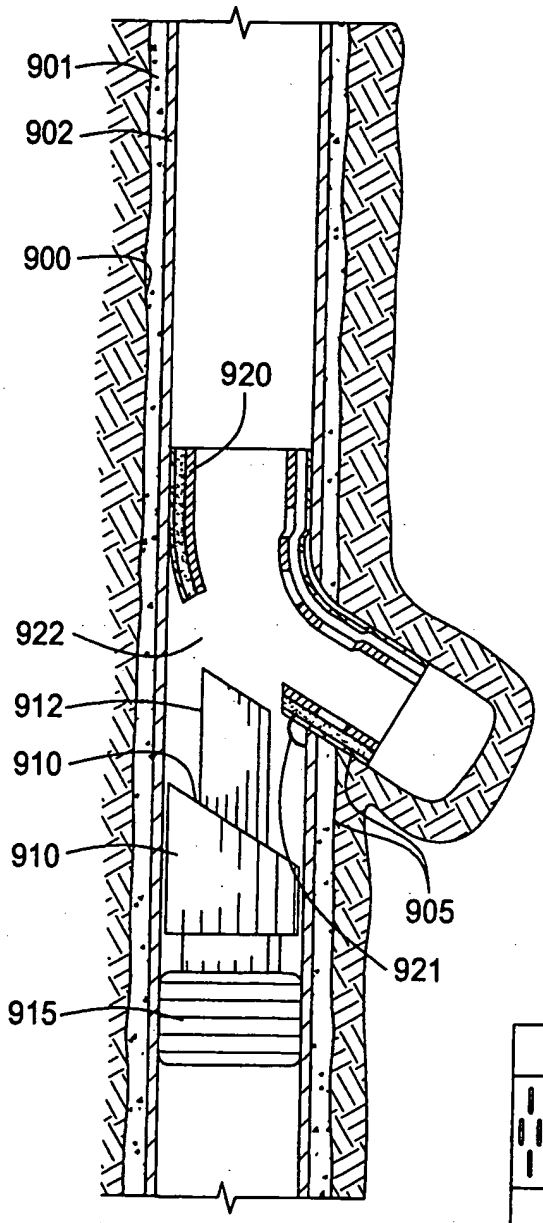

FIG. 30C

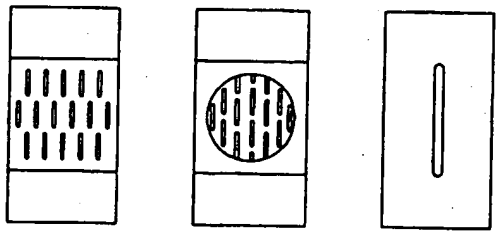

FIG. 30D

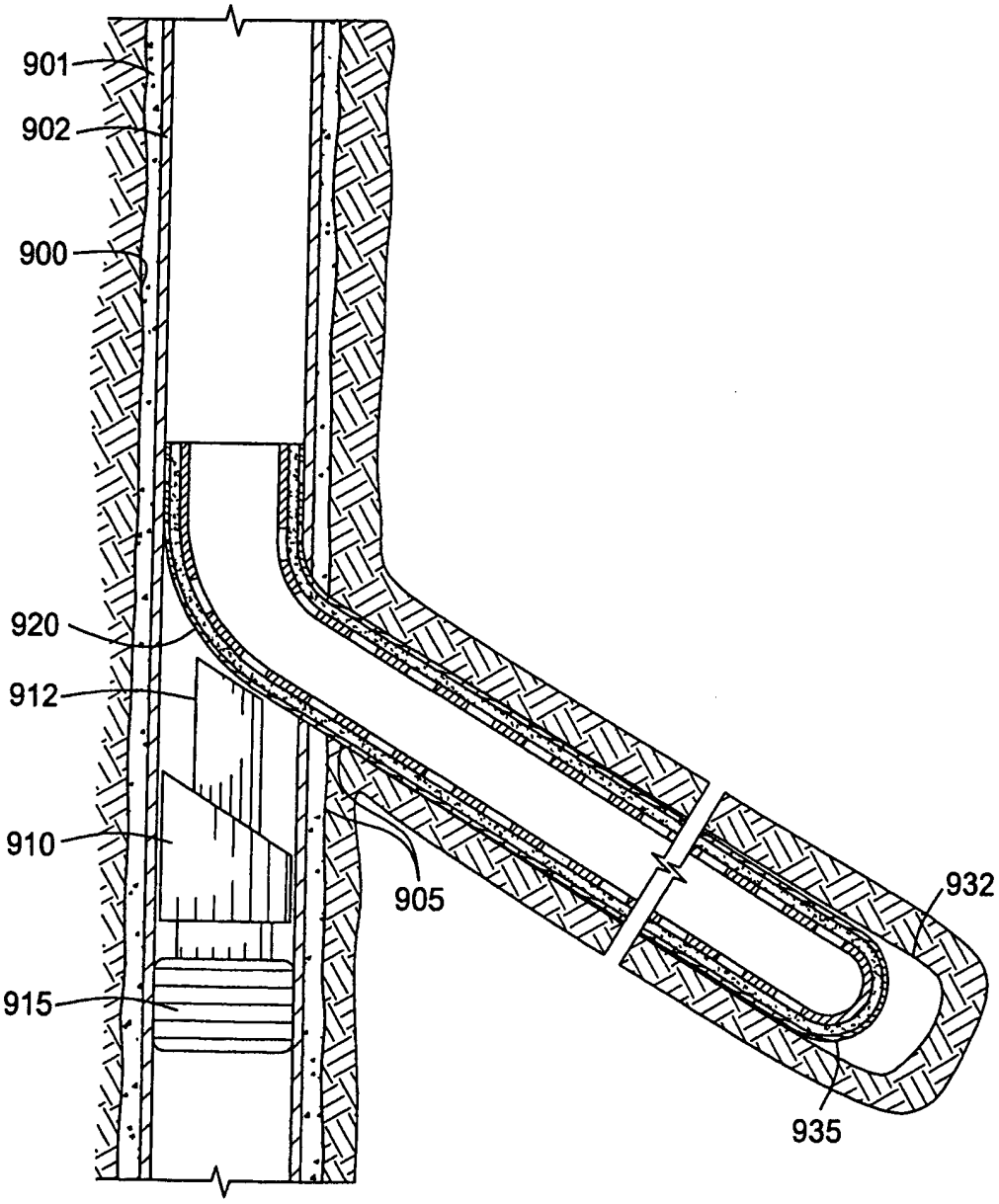

FIG. 31A

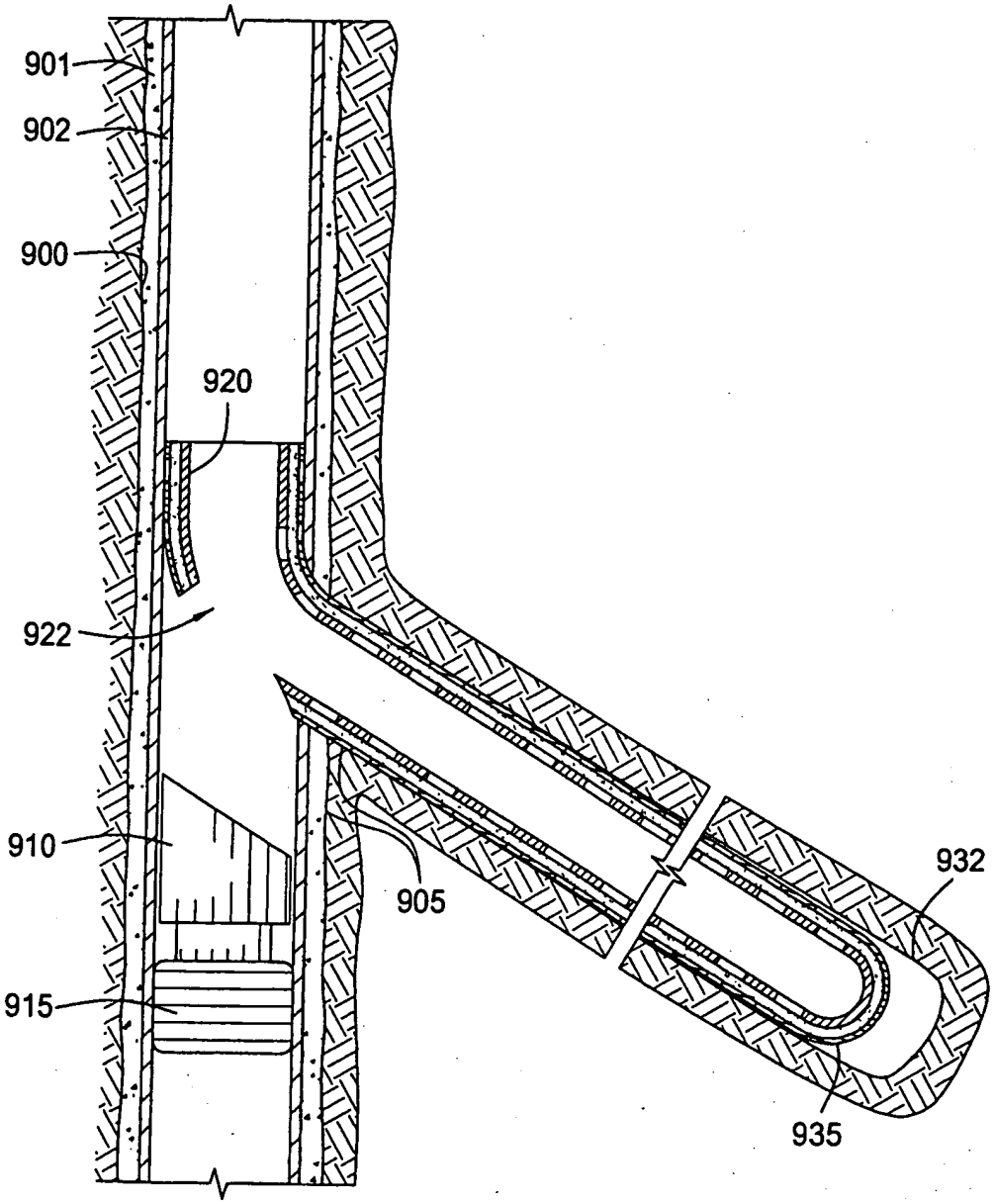

FIG. 31B

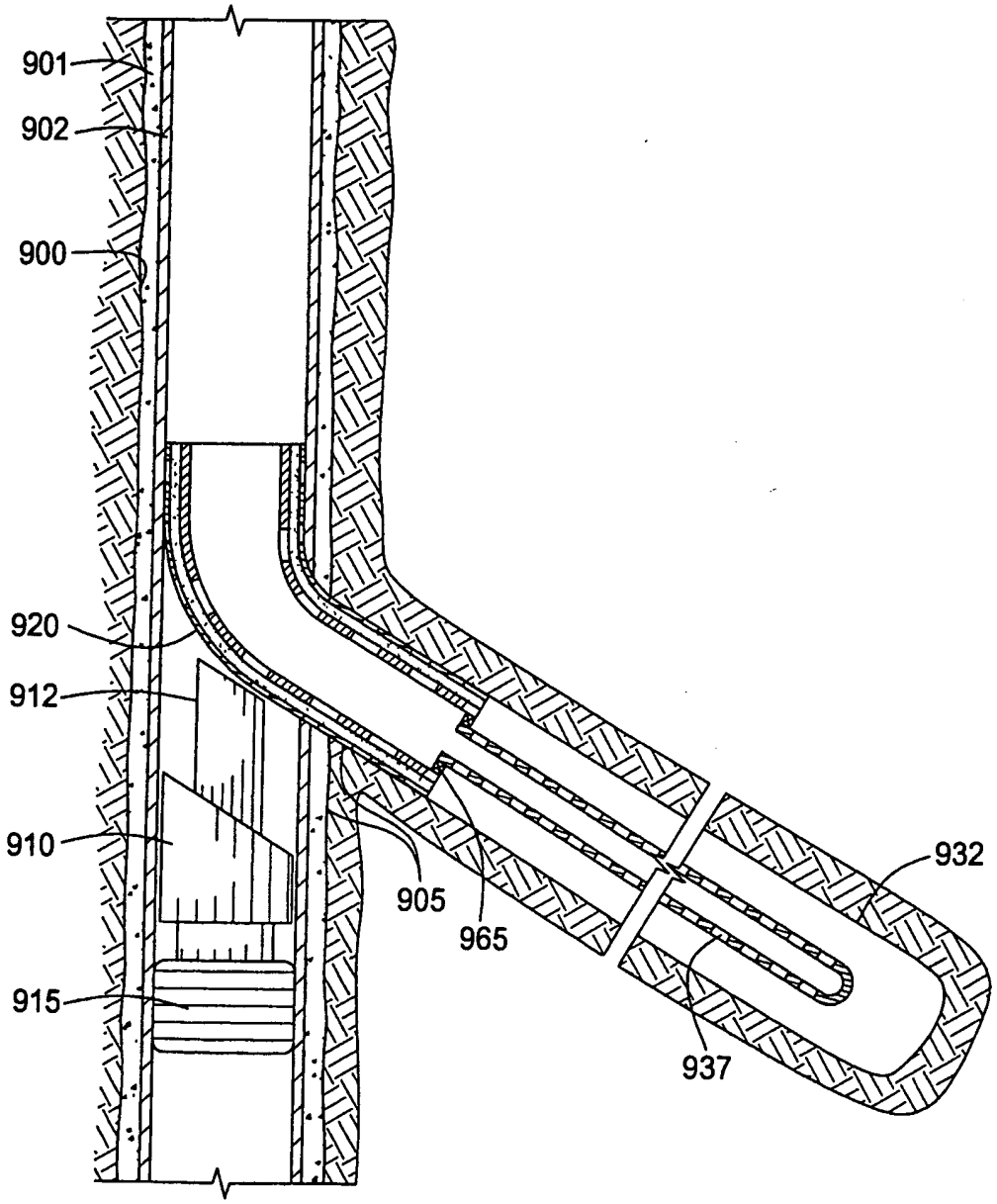

FIG. 31C

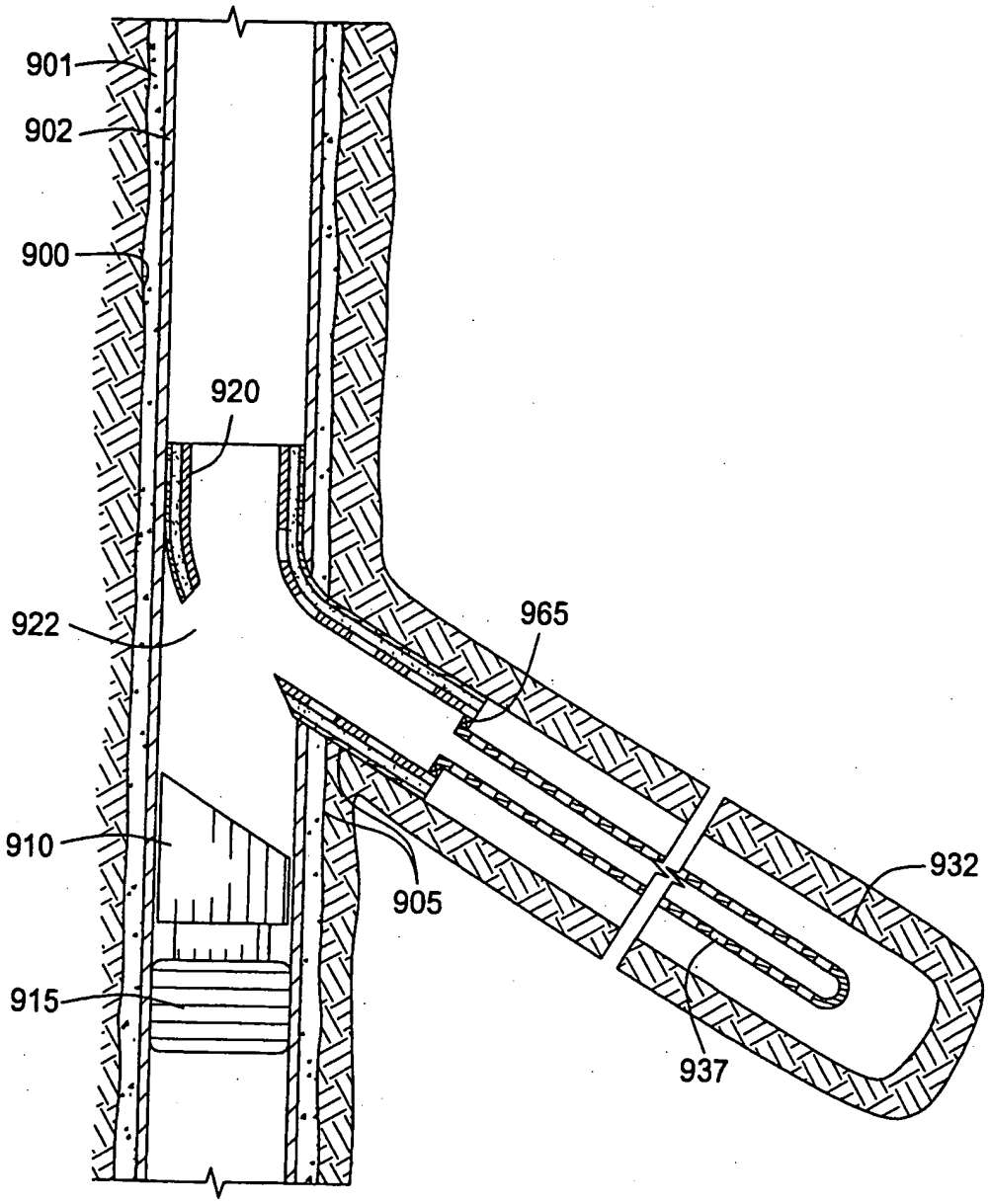

FIG. 31D

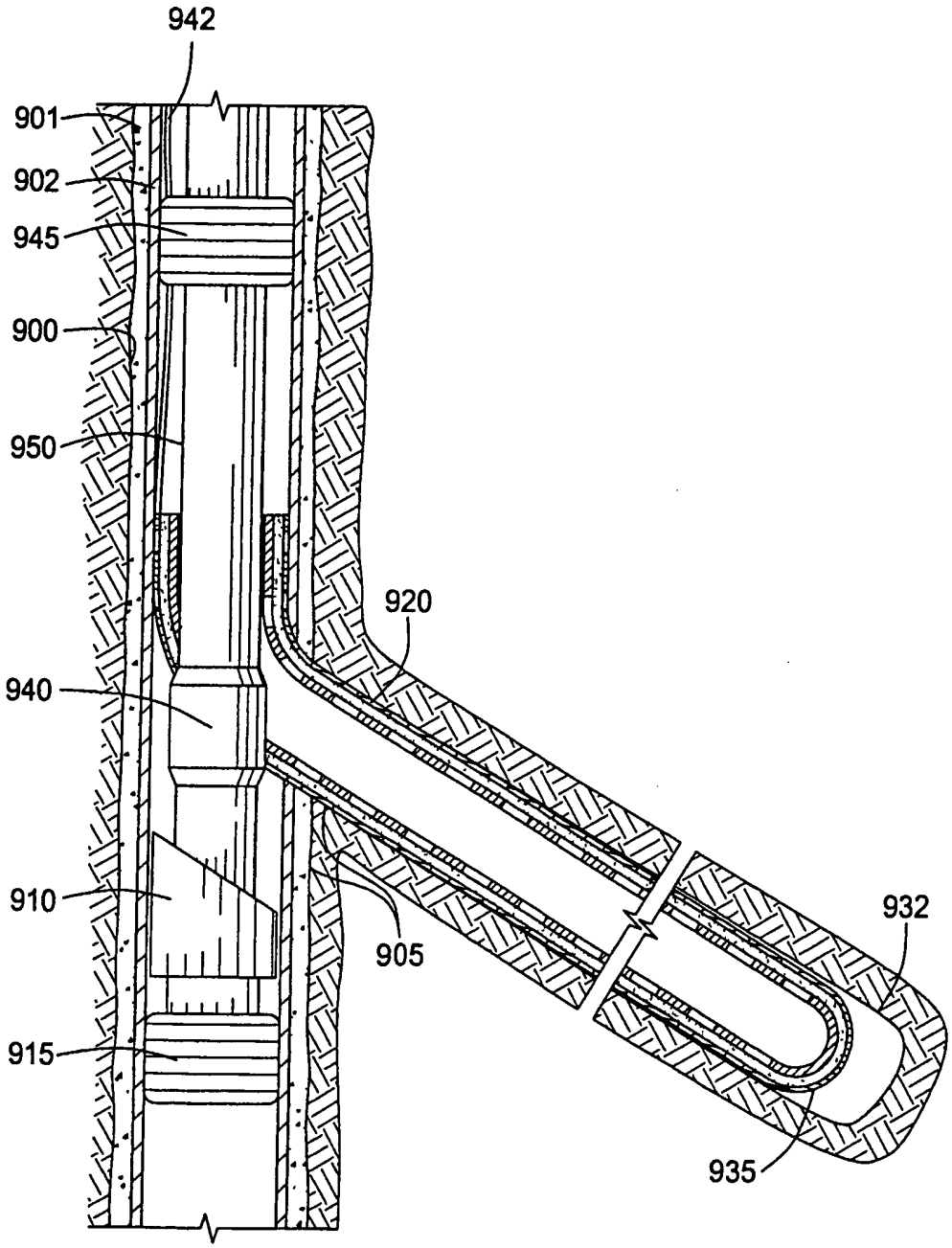

FIG. 32A

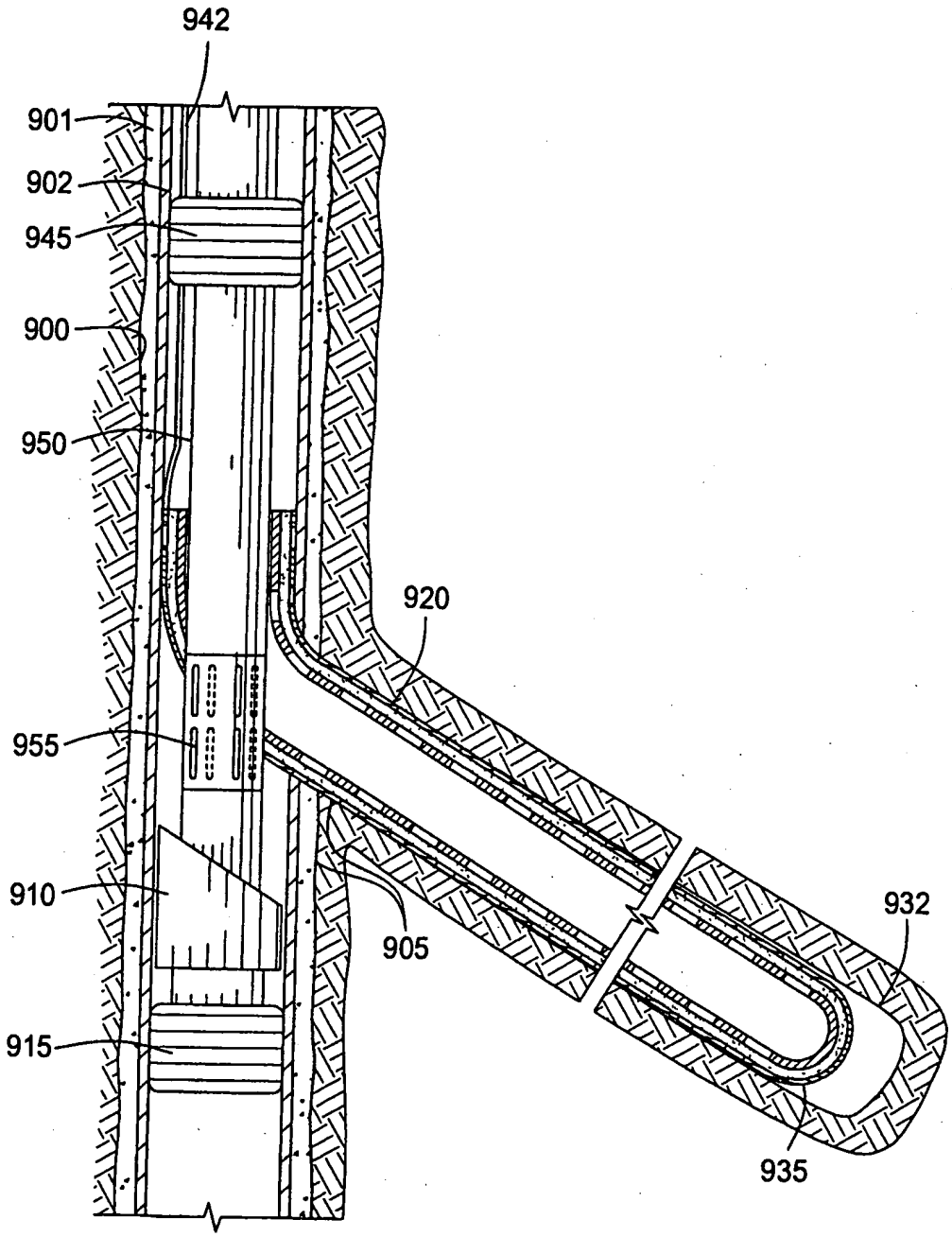

FIG. 32B

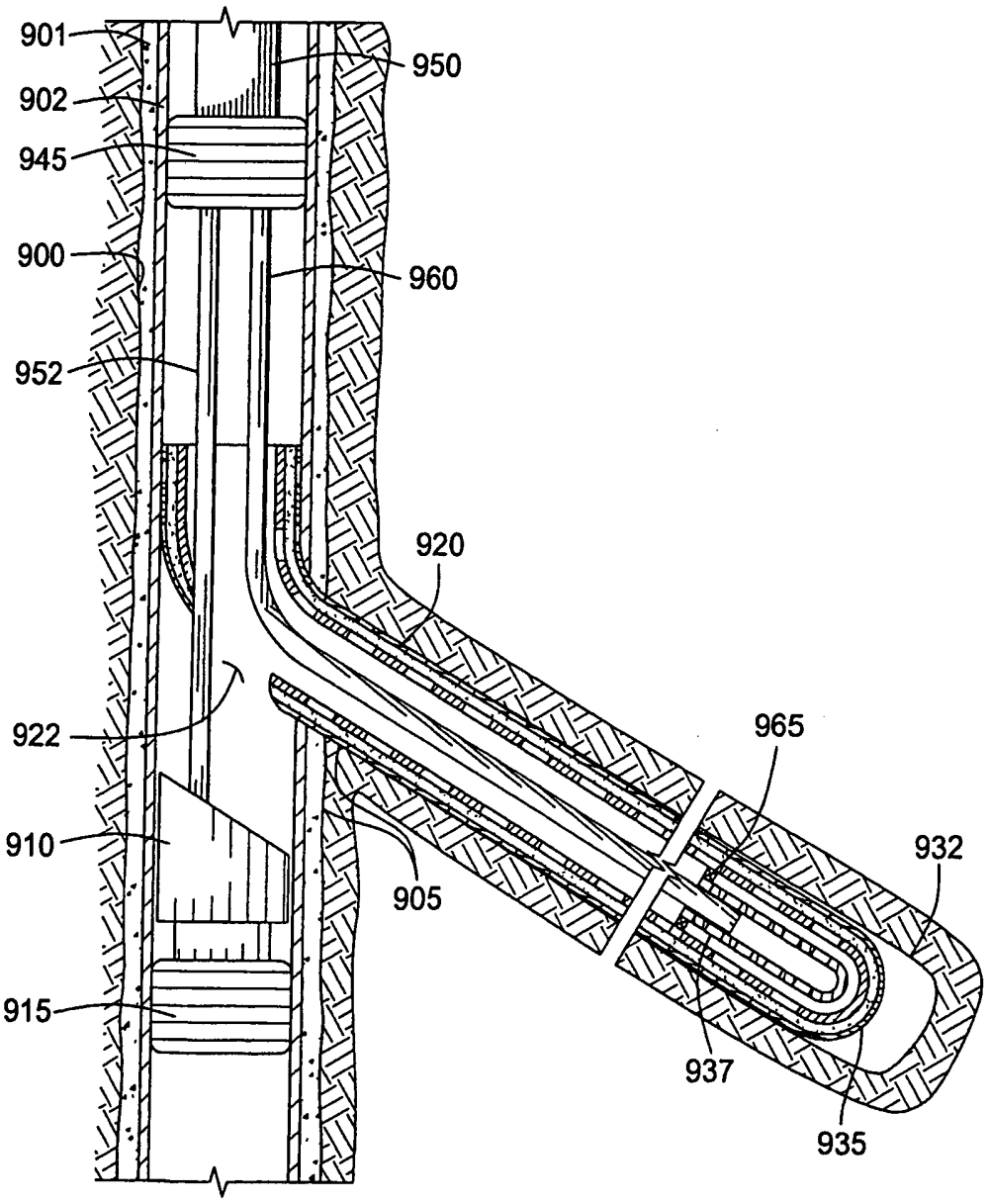

FIG. 32C

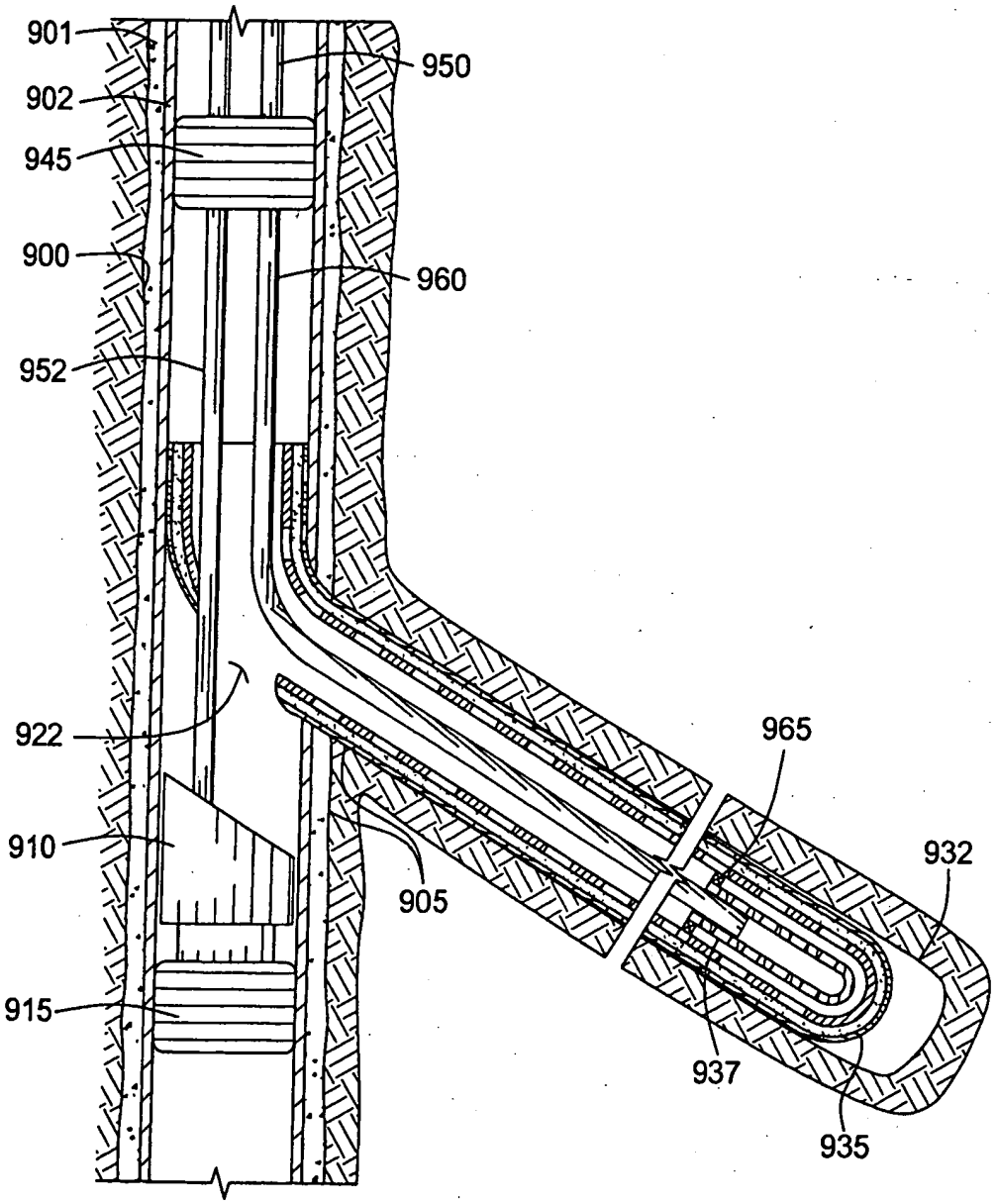

FIG. 32D

APPARATUS AND METHODS TO COMPLETE WELLBORE JUNCTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims benefit of United States provisional patent application serial number 60/424,455, filed November 7, 2002, which is herein incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to methods for completing wells, such as hydrocarbon and water wells. Particularly, the present invention relates to junctions in multilateral wellbores. More particularly, the invention relates to an apparatus and methods for forming and completing junctions, especially junctions designed for solids exclusion.

Description of the Related Art

[0002] Hydrocarbon wells are typically formed with a central wellbore that is supported by steel casing. The steel casing lines the borehole formed in the earth during the drilling process. This creates an annular area between the casing and the borehole, which is filled with cement to further support and form the wellbore.

[0003] Some wells are produced by perforating the casing of the wellbore at selected depths where hydrocarbons are found. Hydrocarbons migrate from the formation, through the perforations, and into the cased wellbore. In some instances, a lower portion of a wellbore is left open, that is, it is not lined with casing. This is known as an open hole completion. In that instance, hydrocarbons in an adjacent earth formation migrate directly into the wellbore where they are subsequently raised to the surface, typically through an artificial lift system.

[0004] Junctions between wellbores are commonplace and are useful to reduce costs associated with drilling, to more completely access a formation and to permit multiple formations to be accessed from a single central wellbore. Typically, a lateral wellbore is formed from a central wellbore at some predetermined location

with the use of a whipstock or some other type of diverter. The lateral wellbore may be formed along with the central wellbore or it may be formed at a later time when the need arises to access some other formation or some other portion of a formation already being produced. When lateral wellbores are drilled from an existing, cased wellbore, a window is formed in a wall of the casing by milling and then the lateral wellbore is drilled through the window.

[0005] However the lateral wellbore is formed, the junction between it and the central wellbore becomes a critical part of the well. In some instances, the lateral wellbore is left unlined and a tubular string is inserted therein to transport wellbore fluids. In other cases, a screen type tubular is inserted into the wellbore to collect fluids that migrate from a surrounding formation. In still other cases, the lateral wellbore is lined with a tubular that is centered in place and perforated at some point to permit the introduction of hydrocarbons. In some cases, it is important to hydraulically isolate a lateral wellbore from the central wellbore. Towards this end, hardware has been developed that is insertable into the area of the junction with tubular members that provide connection means for tubulars running up and down the central wellbore and running out into the lateral wellbore. Through the use of packers and seals, the wellbores can be "plumbed" (or "plugged") in a variety of ways that prevent the co-mingling of fluids between wellbores or portions of the wellbores. A variety of completion options are employed, including the use of a shared production string for delivering production from producing zones in both the primary and lateral wellbores to the surface. Alternatively, separate production tubulars may be used. In any event, it is oftentimes desirable to place sand screens at the actual zones of production in the primary and lateral wellbores.

[0006] Because of their complexity, these junction-lining devices are very expensive to manufacture and their insertion into a wellbore is complex. More importantly, it is not always necessary or even desirable to utilize a device in a wellbore junction that prevents commingling of fluids. Sometimes, the only need is provide some type of structure that will enhance the strength of the junction while not reducing the internal diameter of the wellbores. For example, junctions that are left completely unlined are more likely to suffer cave in or be adversely affected by pressure spikes from one of the wellbores or from a surrounding formation. Additionally, unlined

wellbores have no means to prevent solids from entering the junction and interfering with the production of liquid hydrocarbons. In that respect, an open hole leaves aggregate material, including sand, free to invade the wellbore.

[0007] Sand production can result in premature failure of artificial lift and other downhole and surface equipment. Sand can build up in the borehole and tubing to obstruct fluid flow. Particles can compact and erode surrounding formations to cause liner and casing failures. In addition, produced sand becomes difficult to handle and dispose of at the surface. Ultimately, open holes carry the risk of complete collapse of the formation into the wellbore.

[0008] Heretofore, gravel packs have been utilized in wells to preserve the integrity of the formed borehole, and to prevent the production of formation sand. In gravel packing operations, a pack of gravel, e.g., graded sand, is placed in the annulus between a perforated or slotted liner or screen and the walls of the wellbore in the producing interval. The resulting structure provides a barrier to migrating sand from the producing formation while allowing the flow of produced fluids.

[0009] While gravel packs inhibit the production of sand with formation fluids, they often fail and require replacement due, for example, to the deterioration of the perforated or slotted liner or screen as a result of corrosion or the like. In addition, the initial installation of a gravel pack adds considerable expense to the cost of completing a well. The removal and replacement of a failed gravel pack is even more costly.

[0010] To better control particle flow from unconsolidated formations, an improved form of well screen has been recently developed. The well screen is known as an expandable sand screen, or "ESS tool." The ESS is run into the wellbore at the lower end of a liner string and is expanded into engagement with the surrounding formation, thereby obviating the need for a separate gravel pack. In general, the ESS is constructed from three composite layers, including a perforated base pipe, a protective, slotted outer shroud, and an intermediate filter media. The filter media allows hydrocarbons to invade the wellbore, but filters sand and other unwanted particles from entering. Both the base pipe and the outer shroud are expandable,

with the woven filter being arranged over the base pipe in sheets that partially cover one another and slide across one another as the sand screen is expanded.

[0011] The issues related to unlined junctions are most critical during the time a lateral wellbore is being drilled; long before a conventional junction support could be installed. An operator may want to produce fluids from a formation adjacent the wellbore junction and it is therefore desirable to permit fluids to pass into the wellbore at the junction. However, known hardware used to form the junction is comprised of solid metal materials. Thus, production from the formation at the point of the junction itself has heretofore been impossible. Additionally, it is not unusual to produce from a single formation that is intersected by both the central and lateral wellbores. In these cases, there is no reason to prevent co-mingling of the fluids between the wellbores. Finally, there are instances when cemented junctions become brittle or are damaged by pressure differentials. In these instances, some type of support placed in the junction prior to cementing could serve as a reinforcement of the cement and provide a longer lasting more robust junction.

[0012] Accordingly, a need exists for a method and apparatus for completing a wellbore wherein support is provided for the junction in a multilateral wellbore. Further, a need exists for junction hardware that is not fluid sealed. Still further, a need exists for a junction fabricated from an expandable sand screen so as to prevent sand from entering the production string or otherwise traveling to the surface and being produced.

SUMMARY OF THE INVENTION

[0013] The present invention provides methods and apparatus to complete a junction between two wellbores in a hydrocarbon well. In one aspect of the invention, a junction between a central and lateral wellbore is at least partially lined with a material that prevents solids from migrating into the wellbores but permits fluids to pass therethrough. In another aspect, the junction is lined with a screen-type material to retain strength while the wellbores are completed. In another aspect, the screen-like material provides reinforcement to cement when a junction between wellbores is cemented for hydraulic isolation.

[0014] In another aspect, central and lateral wellbores are drilled in the earth and thereafter, a string of casing is run into the central wellbore having a section therein which includes a preformed window having screen material covering the window. A pre-inserted whipstock adjacent the window permits a liner to be inserted through the window and into the lateral wellbore. As the liner moves through the window, screen material is extended in a manner, which covers an upper portion of the liner and also the junction between the liner and the window. In a second embodiment of the invention, a portion of a central wellbore adjacent a location for drilling a lateral wellbore is under-reamed to produce an enlarged diameter portion of the wellbore. Thereafter, a string of casing with a section having a preformed window with screen therein is lowered into the wellbore adjacent the under-reamed area. Utilizing the whipstock, a string of liner is inserted through the preformed window and, using an expandable drill, the lateral wellbore is formed and the liner is inserted. After formation of the lateral wellbore, the drill is either removed or remains at the end of the lateral wellbore.

[0015] In a third embodiment, the screen is run into the central wellbore on a string of tubulars to the junction. The screen is expanded against a wall of the central wellbore. The screen is extended into the lateral wellbore and expanded against the wall of the lateral wellbore.

[0016] In a fourth embodiment, a first screen is run into the central wellbore on a string of tubulars to the junction and extended or expanded against the wall of the central wellbore. A window is then formed by penetrating the first screen. A second screen is then run through the window into the lateral wellbore and extended or expanded against the wall of the lateral wellbore. The second screen may partially overlap the first screen.

[0017] In a fifth embodiment, a lateral wellbore is formed from an existing, cased central wellbore after a cylindrical section of screen is disposed across a window is formed by milling the casing wall. Thereafter, as with the previous embodiments of the invention, a liner is run-in to the lateral wellbore in a manner that extends the screen material along the outer portion of the liner, causing the screen material to cover the interface between the liner and the window.

[0018] In a sixth embodiment, the screen is placed into the junction according any previous embodiments and cemented into place.

[0019] In a seventh embodiment, a screen is run to the junction on an expandable tubular. The screen is expanded into the lateral wellbore as with previous embodiments. The tubular is then expanded thereby fixing the screen and tubular in the wellbore.

[0020] In an eighth embodiment, an expandable junction component is run into a junction and expanded into place. In one aspect, the component is constructed of a multi-layered sand screen material. In a second aspect, the component comprises a pre-formed central wellbore access port and is only partially expandable.

[0021] In a ninth embodiment, an expandable junction component is run into a lateral wellbore. In one aspect, the junction component is run in with expandable production tubing that may be sand screen. The junction component may just be one end of the expandable production tubing. The junction component and tubing are then expanded against the wall of the lateral wellbore. In a second aspect, the junction component is expanded into place and then conventional production tubing is run into the lateral wellbore and coupled to the junction component. In either aspect, a central wellbore access port may then be milled into the junction component.

[0022] In a tenth embodiment, a lateral wellbore is formed and lined according to the first aspect of the ninth embodiment. If necessary, a central wellbore access port is milled into the junction component. A production string has been lowered into the central wellbore with a packer. In one aspect, a sump pump is provided in the production string. Production may then be from the central wellbore while isolating the junction and the lateral wellbore. In a similar second aspect, the pump is replaced by a sleeve valve. Production may then be from a selection between just the central wellbore and commingled production from the central and lateral wellbores and the junction. In a third aspect, a production string is lowered into the central wellbore to a point just above the junction. Two sub-strings extend from the production string, one into the central wellbore below the junction and one into the

lateral wellbore past the junction. The lateral sub-string is sealingly coupled to the expanded tubing already in place. Production may then be commingled from the central and lateral wellbores while isolating the junction. In a similar fourth aspect, each sub-string is a complete string to the surface. Production may then be separate from the lateral and central wellbores while isolating the junction. Alternatively, any of the previous aspects may be configured to add another production path by removing the packer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0024] Figure 1 is a section view showing a central wellbore with a lateral wellbore extending therefrom.

[0025] Figure 2 is a section view of the central and lateral wellbores of Figure 1 showing a casing with a screen section and a preformed window disposed in the central wellbore adjacent the lateral wellbore.

[0026] Figures 3A – 6B are schematic views of the screen portion of the casing illustrating the manner in which screen material in the window is folded and inserted into the casing prior to run-in.

[0027] Figure 7 is a section view of the central and lateral wellbores illustrating the interior of the screen section and showing a preinstalled whipstock disposed therein.

[0028] Figure 8 is a section view of the central and lateral wellbores illustrating a liner partially inserted into the lateral wellbore via the whipstock.

[0029] Figures 9A, B – 11A, B are sketches illustrating the manner in which the screen material in the window interacts with the liner to extend into the lateral wellbore, covering the external surface of the liner.

[0030] Figure 12 is a partial section view illustrating the liner partially installed through the window of the casing.

[0031] Figure 13 is an elevation view showing the portion of the liner extending from the window completely covered with screen and the screen interface between the liner and the casing window.

[0032] Figure 14 is a section view of a wellbore including a central wellbore having an enlarged diameter portion.

[0033] Figure 15 is a partial section view of the wellbore of Figure 14 illustrating a string of casing inserted in the wellbore with a preformed window formed in the casing and screen material wrapped around the casing at the location of the window.

[0034] Figure 16 is a partial section view of the wellbore after a string of liner has been extended through the casing window.

[0035] Figure 17 is a partial section view illustrating the liner string extending through the window and showing the interface between the liner and the casing window completely covered with screen material. Figure 17 also shows an expandable drill bit forming a lateral wellbore.

[0036] Figure 18 is a partial section view illustrating the lateral wellbore completely formed and the junction between the liner and the casing window completely covered with the screen material.

[0037] Figure 19 is an elevation view of a central wellbore and a lateral wellbore illustrating the use of a screen portion to line and strengthen a junction formed between the two wellbores.

[0038] Figures 20A – 20D illustrate a method for inserting screen portions into a central and lateral wellbores to protect and strengthen the wellbores during drilling operation.

[0039] Figures 21A – 21C illustrate another embodiment of the invention wherein a junction between a central and lateral wellbores is reinforced with screen material prior to forming the lateral wellbore.

[0040] Figure 22 illustrates the use of a screen portion to reinforce cement that is used in and around a wellbore junction.

[0041] Figures 23-29 illustrate the steps of a method wherein the screen is installed on an expandable tubular which is subsequently expanded to fix the screen into the junction.

[0042] Figure 30 presents three cross-sectional views of a multilateral wellbore junction. Each of Figures 30A-30C presents a different expandable junction component that has been installed at the intersection of the primary and lateral wellbores. Figure 30D illustrates different perforation configurations that may be employed in the sand screen junction components.

[0043] Figure 31 presents four cross-sectional views of a multilateral wellbore junction. Figures 31A and 31B illustrate completion of the lateral wellbore with expandable production tubing. Figures 31C and 31D illustrate completion of the lateral wellbore with conventional production tubing.

[0044] Figure 32 presents four cross-sectional views of a multilateral wellbore junction. Figure 32A illustrates pumping from the central wellbore while isolating the lateral wellbore with mono-bore completion to the surface. Figures 32B illustrates selective production between central wellbore production and commingled central wellbore and lateral wellbore production, with mono-bore completion to the surface. Figure 32C illustrates commingled central wellbore and lateral wellbore production while isolating the junction, with mono-bore completion to the surface. Figure 32D illustrates simultaneous separate central wellbore and lateral wellbore production while isolating the junction, with dual-bore completion to the surface.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0045] Figure 1 is a section view showing a central wellbore **100** with a lateral wellbore **200** extending therefrom. Typically, the central wellbore **100** is formed and thereafter, using some whipstock or other diverter that is temporarily placed in the central wellbore **100**, the lateral wellbore **200** is formed to more fully access a formation or to access a different formation adjacent the central wellbore **100**. In this specification, the interface between the central wellbore and the lateral wellbore is considered a wellbore junction and that junction **300** is generally illustrated in Figure 1.

[0046] Figure 2 is a section view illustrating the wellbore **100** with a string of casing **110** disposed therein. In the case of Figure 2, the string of casing **110** includes a section, which includes screen material **120** disposed therein and held at each end by upper and lower rings **115, 118**. Preformed in a wall of the casing **110** at junction **300** is a window **305** visible in profile in Figure 2. The purpose of the screen material **120** disposed within the casing **110** is to insure that screen material **120** covers the preformed window **305** in order to provide means to exclude solids between the lateral wellbore **200** and the casing window **305**, as will be discussed herein. Typically, the screen **120** is disposed within the casing **110** after the preformed window **305** has been formed and the screen **120** is then held tightly to the casing by the rings **115, 118**. The screen material **120** is typically composed of at least one and more multiple layers of metallic, woven mesh and is sized in order to prevent the inflow of solid particles. In some instances, where the screen material **120** might be stretched, the material **120** may include a series of scaled filter sheets which are layered and include the compability of moving laterally in relation to each other without any significant loss of filtering capability. The outer surface of the screen material **120** may include a protective layer, wherein the filter and protective layer are sintered together. This results in a robust screen, **120** wherein the sieve size does not change significantly during or after deformation by stretching. After running the string of casing **110** into the central wellbore **100** and locating the window **305** adjacent the lateral wellbore **200**, the string of casing **110** is typically held in the central wellbore **100** by some type of hanging means or by a separate string of tubulars extending to the surface of the well (not shown).

[0047] Alternatively, the screen **120** may be constructed from three layers, including a perforated base pipe, a protective, slotted outer shroud, and an intermediate filter media. The screen **120** would have rigidity like that of pipe and serve as the casing proximate the junction. The rings **115, 118** would then merely serve to couple the screen **120** to the casing **110**. The window **305** would then be pre-formed in a wall of the multi-layered screen **120** instead of the casing **110**. This multi-layered screen may also be expandable.

[0048] In order to insure that the interface between a string of liner and the window **305** is completely covered with screen **120**, additional screen material may be provided in the area of the preformed window **305**. The additional screen material will form a type of "pant-leg" **250** for a liner is illustrated in Figures 3A-6B. The pant-leg **250** may also comprise three layers. The pant-leg **250** will be folded and housed within the casing **110** at the surface prior to run-in. Figures 3A-6B illustrate that portion of the string of casing **110** that includes the screen material **120** and the preformed window **305**. For clarity, the screen material **120** within the casing **110** is not illustrated but extends between the upper and lower rings **115, 118** as shown in Figure 2. In addition to the screen material **120** within the casing **110**, the additional screen material or pant-leg **250** is illustrated in Figure 3A. Figure 3B is a view of 3A taken from the bottom, illustrating the pant-leg **250** having a circular shape prior to installation into the casing **110**. Figure 3A illustrates the pant-leg 250 fully extended as it will appear in the lateral wellbore after the string of liner inserted through the window **305**.

[0049] In order to prepare the pant-leg **250** portion of the screen material **120** for insertion into casing **110**, the material is first folded upwards into a folding portion **255** as illustrated by the dotted line portion of the pant-leg **250** visible in Figure 4A. After the folded portion **255** is formed, pant-leg **250** is folded, the bottom view of the assembly visible in Figure 4B illustrates the relative proximity of the bottom of the pant-leg **250** to the casing **110**. Figure 5A illustrates additional manipulation of the cuff portion **255** of the pant-leg **250**. Specifically, as illustrated in Figure 5B, a bottom view of the assembly, the folded portion **255** is shaped into a crescent shape **260** as a center portion is urged inward in relation to the outer edges. Thereafter, the outer edges of the crescent shape **260** are manipulated inwards to a point where

the pant-leg **250** is completely housed in the casing **110**, as shown in Figure 6A and Figure 6B, a bottom view of the assembly illustrating the relative position of the screen material **120** relative to the casing **110**.

[0050] Not shown in Figures 3A-6B is a whipstock which may be disposed in the casing **110** adjacent the preformed window **305** at the surface prior to folding the pant-leg **250**. The whipstock includes a cut-out portion **275** (see Figure 7) constructed and arranged to hold the folded portion **255** of the screen as the casing **110** is run into the wellbore. Specifically, the folded portion **255** is housed in the cut-out in order to avoid interfering with a string of liner as it run down the whipstock and through the casing window **305** as will be described herein.

[0051] Figure 7 is a partial section view of the central and lateral wellbores **100, 200** illustrating that section of casing **110** in the central wellbore **100** which includes the preformed window **305** and shows especially a whipstock **270** which is inserted in the casing **110** prior to run into the central wellbore **100** as well as a cut-out portion **275** of the whipstock which includes the folded portion **255** of the pant-leg **250**. As discussed previously, the cut-out portion **275** serves as a housing for the folded portion **255** to prevent the folded portion **255** from interfering with use of the whipstock **270** when a string of liner is inserted into the lateral wellbore **200**. Also visible in Figure 7 is an anchor assembly **280** which is used to temporarily anchor the whipstock **270** in the casing **110** while a liner is run into the lateral wellbore **200**.

[0052] Figure 8 is a partial section view similar to Figure 7 but illustrating a string of liner **310** partially run along an inclined surface **271** of the whipstock **270** and having made initial contact with the screen material **120**. Visible specifically in Figure 8 is the folded portion **255** of the pant-leg **250** as it is partially urged away from the cut-out portion **275** of the whipstock **270** by a leading edge **306** of the string of liner.

[0053] Figures 9A-11B illustrate the movement of the pant-leg **250** and the folded **255** portion of the screen as it is urged into an extended position in the lateral wellbore by the liner as the liner extends through the preformed casing window **305** and into the lateral wellbore. Figure 9A and 9B correspond to Figure 8, showing the

folded portion **255** of the pant-leg **250** partially pushed through the window **305** formed in the casing **110**. As shown in Figure 9B, the folded portion **255** is in the crescent shape **260** as it begins to unfold.

[0054] In Figures 10A, B, the pant-leg portion **250** is completely extended through the window **305** due to the insertion of the liner string and only the folded portion **255** remains. Finally, Figures 11A and 11B illustrate the pant-leg portion **250** completely extended as it would appear once the liner string has been completely inserted into the lateral wellbore.

[0055] Figure 12 corresponds basically to Figures 10A and 10B and illustrates the pant-leg portion **250** of the screen extended out into the lateral wellbore **200** but with the folded portion **255** still remaining folded within. The whipstock is no longer visible in the central wellbore **100** and typically would have been removed. In Figure 13, an elevation view of the central **100** and lateral **200** wellbores the pant-leg **250** is shown fully extended as it appears after the string of liner **310** has been completely inserted. Visible specifically in Figure 13 is the interface or junction **300** between casing window **305** and the string of liner **310** in the lateral wellbore **200**. As is apparent from Figure 13, the junction **300** is now completely sealed with the screen material **120** and while fluids may pass through, the passage of solids is effectively blocked depending upon the characteristics of the screen material **120**.

[0056] In another embodiment of the invention, a lateral wellbore is formed through a window having a screen portion like the one previously described. Figure 14 illustrates a central wellbore **100** with an enlarged diameter portion **105** formed therein. Typically, the larger diameter portion is formed with an under reamer (not shown) that includes some type of extendable blade members that can be selectively extended to enlarge the diameter of a section of wellbore. The purpose of the enlarged diameter portion **105**, as will be explained herein, is to permit a liner string (not shown) to be at least partially inserted through a casing window (not shown) prior to the formation of a lateral wellbore. Figure 15 is a partial section view of the wellbore of Figure 14 showing the string of casing **110** installed into the central wellbore **100** and having the preformed window **305** in a wall thereof. In Figure 15 the window **305** is visible in profile. Also included in the casing string **110**

adjacent the window **305** is a pre-located whipstock (not shown) that will be used to run a string of liner (not shown) through the window **305**. Additionally, as with the previous embodiment, the screen portion **120** is disposed within the casing **110** and held by rings **115**, **118** at an upper and lower end. As with the previous embodiment, also included is a pant leg portion (not visible) of the screen **120** that is initially housed in a cut-out portion of the whipstock (see Figures 3A - 6B).

[0057] Figure 16 is a section view that shows the liner string **310** being inserted through the window **305** and into the enlarged diameter area **105** of the wellbore. As with the previous embodiments, the movement of the liner string **310** along an inclined surface of the whipstock causes a folded portion of the pant leg to straighten out and the pant leg to be carried towards that portion of the wellbore from which the lateral wellbore will extend.

[0058] Figure 17 is a partial section view showing the liner **310** extended completely through the window **305** to a point wherein the pant leg portion **250** of the screen is completely extended and the interface or junction **300** between the liner **310** and the window **305** formed in the casing **110** wall is completely covered with the screen material **120**. At a lower end of the liner **310** is a separate string of drilling tubulars **320** and a bit **325** disposed at the end thereof. In the preferred embodiment, the bit **325** is initially fixed and housed within the end of the liner string **310**. After the end of the liner **310** has been inserted through the casing window **305** and into the enlarged diameter portion **105** of the central wellbore **100**, the bit **325** is remotely disconnected from the liner **310** and can be moved axially with respect to the liner **310**. Additionally, with the use of a mud motor (not shown) or other device that can transfer fluid flow to rotational movement, the drill can be rotated to form the lateral wellbore. Also, in the preferred embodiment, the bit **325** is an expandable bit with extendable portions that can be selectively and remotely activated to enlarge the diameter of the bit **325** to a size greater than the outer diameter of the liner **310**.

[0059] Figure 18 is a partial section view showing the lateral wellbore **200** completely formed and the interface or junction **300** between the liner **310** and the casing window **305** completely covered with the screen material **120**. Typically, the whipstock in the casing **110** is removed after formation of the lateral wellbore **200**

and the expandable bit (not shown) is left in the end of the newly formed lateral wellbore **200**.

[0060] Figure 19 is an elevation view of a central wellbore **100** and a lateral wellbore **200** illustrating the use of a screen portion **120** to line and strengthen a junction **300** formed between the two wellbores **100, 200**. The screen portion **120** would typically be run-in into the wellbore **100** on a string of tubulars (not shown) and then, a central portion **410** of the screen **120** expanded against a wall of the central wellbore **100** and a lateral portion **415** extended and expanded against a wall of the lateral wellbore **200**. Due to the relatively stiff nature of the screen material **120**, it can easily be transferred downhole in a collapsed or folded orientation and subsequently extended and expanded to take the shape illustrated in Figure 19. In Figure 19, the central wellbore **100** also includes a casing **110** which enters an upper end of the central portion **410** of the screen **120** and exits a lower end thereof permitting the central wellbore **100** to be utilized below the reinforced junction **300**. Alternatively, or in addition to the casing **110** running vertical through the screen portion, a string of liner (not shown) could extend through the lateral portion **415** and into the lateral wellbore **200** therebelow.

[0061] Figures 20A – 20D illustrate a method for inserting screen portions **120** into a central **100** and lateral **200** wellbores in order to protect and strengthen the wellbores **100, 200** during drilling. Figure 20A shows the central wellbore **100** with the lateral wellbore **200** extending therefrom. Disposed along the walls of the central wellbore **100** is a tubular screen portion **120** which is run-in into the wellbore **100** and extended or expanded therein to contact the wellbore **100** walls. Figure 20B illustrates the central and lateral wellbores **100, 200** of Figure 20A with the screen portion **120** having been penetrated and a window **305** formed therein to permit communication between the central and lateral wellbores **100, 200**. Figure 20C illustrates a second tube-shape screen portion **420** which has been run into the lateral wellbore **200**, inserted through the window **305** formed in the first screen portion **120** and then extended or expanded against the walls of the lateral wellbore **200**. Finally, Figure 20D illustrates the wellbore junction **300** completely lined and strengthened with the screen material **120, 420**. The second tubular shape screen member **420** has been deformed whereby a portion of it extending into the central

wellbore **100** has been folded down to further line the central wellbore **100** below the window **305**. In this manner, using separate tubular screen members **120, 420** any portion of a wellbore junction **300** can be selectively lined and strengthened. Additionally, while the illustration shows only one lateral wellbore **200**, it will be understood that any junction can be reinforced, even one having multiple lateral wellbores extending therefrom.

[0062] Figures 21A – 21C illustrate another embodiment of the invention wherein a junction **300** between a central and lateral wellbores **100, 200** is reinforced with screen material **120** prior to forming the lateral wellbore **200**. Figure 21A illustrates the central wellbore **100** having casing **110** disposed therein. Located in the casing **110** is a whipstock **270** having an inclined surface **271** and, thereabove, a milling bit **325** as would be run into the wellbore **100** and used to form a window **305** in a wall of the casing **110**. Milling bits **325** are well known in the art and typically are used to form casing windows and thereafter they are removed from the wellbore and replaced with a more conventional drill bit which forms the lateral wellbore **200**. Figure 21B illustrates the central wellbore **100** after window **305** has been formed in the wall of the casing **110** by the milling bit which has been removed. As illustrated in Figure 21B, the formation of the casing window **305** necessarily results in an extension **425** which is formed in the earth outwards of the window **305**. Figure 21C illustrates the central wellbore **100**, the casing window **305** and the extension **425** after the junction **300** between the wellbore **100** and extension **425** has been reinforced with screen material **120**. As with previous embodiments, the screen material **120** may be run into and inserted at the junction **305** in a variety of ways. For example, a tubular shape of the screen can be run into the wellbore **100** in a collapsed condition and thereafter urged through the casing window by a bent sub or a diverting device (not shown). Thereafter, using a cone-shaped object (not shown) run-in on a string of tubulars (not shown), the screen **120** can be expanded into contact with the walls of the central wellbore **100**, and the extension **425**.

[0063] In addition to those methods described, the screen portion **120** may can be expanded using an expander tool (i.e., see Figures 26-29) which includes at least one radially extendable member disposed on a body and extendable through fluid pressure delivered to the body through a string of tubulars having pressurized fluid

therein. Expander tools are well known in the art and an example of one is taught in U.S. Pat. No. 6,425,444, assigned to the same owner as the present application and that patent is incorporated herein in its entirety.

[0064] Figure 22 illustrates a central wellbore **100** having a lateral wellbore **200** extending therefrom and specifically teaches the use of the screen portion **120** of the invention to reinforce cement **430** that is used in and around a wellbore junction **300**. In Figure 22 the junction **300** between the central and lateral wellbores **100, 200** has been strengthened through the use of at least one screen portion **120** as described with reference to other embodiments of the invention. Thereafter, tubular strings (not shown) in each wellbore **100, 200** are cemented in place using cementing techniques well known in the art. Rather than leaving a layer of fragile cement **430** between a tubular member and the earthen walls of the wellbores **100, 200**, the screen **120** is at least partially permeated by the cement **430** and serves as a reinforcing member to protect the cement **430** from shock and breakage, especially due to pressure differentials.

[0065] In another embodiment of the invention, a screen portion is utilized in a junction of wellbore which is created from an existing, cased central wellbore. Figure 23 is a section view illustrating a central wellbore **500** with casing **510** cemented therein. Figure 24 is a section view of the wellbore after a window **520** has been formed in a wall of the casing **510**. Visible in Figure 24 is a whipstock **530** held in place by an anchor **535** and having an inclined portion **540** which is utilized by a mill and drill bit which forms the casing window and a lateral wellbore **550**. Figure 25 is a section view of the wellbore illustrating the junction **560** between the central and lateral wellbores. The apparatus used in forming the casing window **520** and the lateral wellbore **550** has been removed and a tubular member **565**, housing various components, has been lowered into the wellbore. The tubular member includes a window **570** formed therein as well as an upper and lower rings **580, 585** used to retain a screen portion (not shown) around the tubular member **565**. Figure 26 is a section view of the tubular member **565** showing the various components therein. From the top of Figure 26 towards the bottom, the components include a run-in string **590**, an expander tool **600**, a torque anchor **605** disposed therebelow and a cone member **610** disposed below the torque anchor. Disposed further

downwards in the tubular member is a whipstock **615** having a cut-out portion **620** formed therein constructed and arranged to house a pant-leg portion **625** of screen. Disposed below the whipstock is a packer **630**. The screen portion, including the pant-leg portion **625** is arranged in the tubular member and within the cut-out portion **620** of the whipstock in a similar fashion as discussed with previous embodiments. The tubular member **565** may be replaced by the multi-layered, expandable screen discussed above.

[0066] Figure 27 is a section view of the apparatus illustrating the cone member **610** having been extended downwards along an inclined surface **635** of the whipstock to a location whereby it interferes and upsets the pant-leg portion **625** of the screen. As shown in Figure 27, the cone **610** is extended downward and has urged a folded portion of the pant-leg **625** outwards towards the lateral wellbore **550**. The cone moves downward on a relatively small diameter pipe **640** which is movable axially independently of the other components. As the screen portion is manipulated, the tubular member and other components are held in the wellbore by torque anchor **605** which includes radially extendable gripping portions **606** disposed therearound.

[0067] Figure 28 illustrates the pant-leg portion **625** of the screen completely unfolded and extended out into lateral wellbore **550**. With the pant-leg portion completely extended outwards, the expander tool can be activated and radially extendable rollers thereupon extend outward to push walls of the tubular portion into gripping contact with the casing therearound. In this manner, and with some axially movement of the expander tool, the assembly including the tubular member and the components therein becomes fixed in the wellbore. Thereafter, with the packer **630** disengaged and the torque anchor and expander tool deactivated, the assembly, including the whipstock **615** can be removed from the wellbore. Alternatively, the expander tool can be moved downwards to a position below the window and reactivated, thereby sealing an annular area formed between the outer surface of the tubular member and the casing wall. In this manner, any flow of fluid is prevented from passing through the wellbore without coming into contact with the screen portion.

[0068] Figure 29 illustrates the components removed leaving only the tubular portion **565** with its preformed window **520** and the screen therein and a string of liner **650** extending through the window and into the lateral wellbore **550**. A whipstock used to insert the liner through the casing window has also been removed. As is visible in Figure 29, the junction **560** between the liner and the casing window is substantially covered with the screen material and any solids can be filtered while fluids can pass through the screen material. Expanded portions **566**, **567** seal the annular area between the casing and the tubular portion **565**.

[0069] **Figures 30A-C** present three cross-sectional views of a multilateral wellbore. In one embodiment, a lateral wellbore junction **905** has been formed off of a cased **902** and cemented **901** primary wellbore **900**. In order to accomplish this, a whipstock (not shown), a deflector **910**, and an anchor **915** are lowered into the primary wellbore **900**. The whipstock is properly oriented and located using conventional MWD, gyro, pipe tally, or radioactive tags. The anchor **915** is set. A window is milled/drilled through the casing **902** and the cement **901**, using the whipstock (not shown) as a guide, and the drilling is continued until a junction **905** is formed. Since expandable junctions **920** will be installed, the wellbore junction **905** may be under-reamed, such as with a bi-center or expandable bit, resulting in an inside diameter near that of the central wellbore **900**. The whipstock (not shown) is removed and replaced by a deflector stem **912**. The deflector stem **912** and deflector device **910** may comprise a mating orientation feature (not shown), such as a key and keyway, for properly orientating the deflector stem into the deflector device. The deflector device **910** and the anchor **915** may comprise a flow port (not shown). The anchor **915** may further comprise packing means or may be a separate anchor and packer. Once the deflector stem **912** is set, an expandable (or partially expandable, see below) junction component **920** (unexpanded) is lowered through the primary wellbore, along the deflector stem **912**, to the junction **905**. The junction component **920** is then expanded against the walls of the primary wellbore **900** and the junction **905** using an expander tool (i.e., see **Figures 26-28**). In each instance, the expandable components **920** are set and expanded before completing the lateral wellbore to prevent damage of the junction **905** due to subsequent drilling of the lateral wellbore.

[0070] Depicted in **Figure 30A** is an expandable sand screen junction component **920**, such as Weatherford's ESS®. Three layers of the sand screen **920** are shown, representing a perforated base pipe **920c**, a protective outer shroud **920a**, and an intermediate filter media **920b**. Slots are seen within the base pipe **920c** and the shroud **920a**. In **Figure 30**, the sand screen **920** is shown in its expanded position. In this manner, the sand screen **920** is expanded downhole against the casing **902** and the junction **905** in order to preserve the integrity of the junction **905** during subsequent drilling and production. A more particular description of an expandable sand screen is described in U.S. Patent No. 5,901,789, which is incorporated by reference herein in its entirety.

[0071] Illustrated in **Figure 30B** is a solid expandable junction component **920**. Depicted in **Figure 30C** is a partially expandable sand screen junction component **920** with a preformed central wellbore access port **922**. In **Figure 30C**, note that the component **920** is shown only partially expanded because the preformed port **922** may not allow expansion of the component over the portion it covers. A mating feature, such as a hook **921**, is provided on the partially expandable junction component to retain it inside the junction during expansion and to properly locate and orient it at the junction. The mating feature may be disposed on the other junction components. The hook **921** may be permanent, temporary, or shearable. Other means can be used to orient and locate the junction components, such as conventional MWD, gyro, pipe tally, or radioactive tags. The partially expandable component **920** may also be solid. **Figure 30D** illustrates various perforation configurations that may be formed in the sand screen junction components. As discussed earlier, the sand screen junction components will allow production at the junction **905** while filtering particulate matter out of the production fluid. The sand screen components shown in **Figures 30A** and **30C** need not be multi-layered.

[0072] **Figures 31A-B** and **31C-D** provides two alternate completion methods to that displayed in **Figures 30A-C**. In this embodiment, a lateral wellbore **932** has been formed off of a cased **902** and cemented **901** primary wellbore **900**. Contrary to the earlier described method, the entire lateral wellbore **932** is drilled before installation of the junction component **920**. In **Figure 31A**, the junction component **920** is installed with expandable sand screen production tubing **935** extending through

lateral wellbore **932**. The component **920** and the production tubing **935** are expanded together in one step. Expansion of the sand screens **920** and **935** obviates the need for a gravel pack, and allows for a larger i.d. within the junction **905**. The junction component **920** does not have to be separate from the production tubing **935**; it may just comprise the portion of the production tubing **935** located in the vicinity of the junction **905**. The production tubing **935** may be sand screen, solid, or a combination of both. Any of the junction components **920** displayed in **Figures 30A-C** may be used. For example, if there is no reservoir in the vicinity of the junction **905** or if there is a reservoir containing undesirable fluid, i.e. water, a solid junction component **920** would be preferable so as to isolate the junction. This would prevent escape of production fluid into the junction **905** in the former case and prevent commingling of an undesirable fluid in the latter case. If production equipment is desired in the central wellbore **900** below the junction (discussed below), the junction component **920** must be milled out to create a central wellbore access port **922** as shown in **Figure 31B**. The deflector stem **912** may also be retrieved after milling as shown in **Figure 31B**. If the solid junction component **920** is used, it must be milled to allow production from the central wellbore **900** below the junction **905**.

[0073] In **Figure 31C**, the expandable sand screen junction component **920** is installed before any production tubing **937**. The production tubing **937** is then lowered through the expandable junction component **920** and coupled to the end of the junction component proximate the lateral wellbore **932** by a packer **965**. The packer **965** may be part of a liner hanger. In this embodiment, the production tubing **937** is conventional (non-expandable) and slotted. This configuration is preferable for the case where a desirable reservoir (not shown) extends the length of the junction **905** and lateral wellbore **932**, since the junction is not isolated from the lateral wellbore. The production tubing **937** may be solid when installed and later perforated by known means, such as perfing, chemical cut, mechanical cut, milling, drilling, explosives, dissolving, piercing, forming, or punching. Again, if additional production equipment is desired in the central wellbore **900** below the junction **905**, then the slotted junction component **920** must be milled as shown in **Figure 31D**. Again, the deflector stem **912** has been retrieved from the deflector device **910** as

shown in **Figure 31D**. Of course, the lateral wellbore **932** may be left open and no production tubing provided, if desired. Again, any of the junction components **920** displayed in **Figures 30A-C** may be used.

[0074] Either completion method, discussed with reference to **Figures 31A-B** or **Figures 31C-D**, may comprise the extra steps of first drilling the junction **905**, installing the junction component **920**, and then drilling the lateral wellbore **932** to completion as discussed above with reference to **Figure 30**.

[0075] **Figures 32A-D** provide four alternate completion methods for a multilateral wellbore. In each instance, a lateral wellbore **932** has been formed off of a cased **902** and cemented **901** primary wellbore **900**. A junction component **920** is shown in each view. Further, in each view, the central wellbore access port **922** has been formed (or pre-formed) in the bottom of the junction component in order to provide access to the primary wellbore **900** below the junction **905**. The junction **905** and lateral wellbore **932** configurations shown in **Figure 32** have been completed according to the methods discussed above with reference to **Figures 31A** and **31B**. These configurations could also be completed with the methods discussed above with reference to **Figures 30, 31C,** and **31D**.

[0076] Shown in **Figures 32A** and **32B**, a single production string **950** comprising a packer **945** is run from the surface, through the junction **905**, and to the deflector **910** and anchor **915**. The packer **945** is set above the junction **905** in the central wellbore **900**. In **Figure 32A**, a sump pump **940** having a control line **942** is disposed in the production string **950** for production in the central wellbore **900** below the junction **905**. The lateral bore **932** and junction **905** are isolated by the packer **945**, deflector device **910**, and anchor/packer **915**, thus prohibiting any production from them. In **Figure 32B**, a remotely operated sleeve valve **955** having the control line **942** is included in the production string **950** at or near the location of the junction **905**. This enables an operator to select production from the central wellbore **900** or commingled production from the central wellbore, junction **905**, and lateral wellbore **932**. The sleeve valve may also be used in the configuration shown in **Figure 32A** to allow for production from the junction **905** and the lateral wellbore **932**.

[0077] The control line **942** runs within an encapsulation from the surface (not shown) along the production string **950**. The encapsulation **12** is secured to the production string **950** by clamps (not shown). The clamps are typically secured to the production string **950** approximately every ten meters. The encapsulation **12** passes through the packer **945** (or utilized hanging apparatus), and extends downward to the top of the sand screen **920**. The control line **942** enters a recess (not shown) in the outer diameter of the junction component **920**. Arrangements for the recess are described more fully in the pending application entitled "Profiled Recess for Instrumented Expandable Components," having S/N No. 09/964,034, which is incorporated herein in its entirety, by reference. However, the control line **942** may also be housed in a specially profiled encapsulation around the component **920** which contains arcuate walls. Arrangements for the encapsulation are described more fully in the pending application entitled "Profiled Encapsulation for Use With Expandable Sand Screen," having S/N No. 09/964,160, which is also incorporated herein in its entirety, by reference.

[0078] Illustrated in **Figures 32C** and **32D**, production tubing **937** having the packer **967** is lowered into the lateral wellbore **932** and the packer **967** is set against the expandable tubing **935**. This configuration will allow production string or sub-string **960** to be coupled with tubing **937**. Referring to **Figure 35C**, the production string **950**, comprising the packer **945** and sub-strings **952** and **960**, is run from the surface. The central sub-string **952** extends from the packer **945**, which is again placed in the production string **950** above the junction **905**, through the port **922** in the junction, and to the anchor **915** and deflector **910**. The lateral production sub-string **960** extends from the packer **945**, through the junction **905**, to the production tubing **937**. The result is commingled production from both the central wellbore **900** and the lateral wellbore **932** while completely isolating the junction **905** with the packers **945** and **965** and the anchor/packer **915**. The configuration shown in **Figure 32D** is similar to the one shown in **Figure 32C** except that two production strings **952** and **960** coupled by packer **945** are run from the surface. The result is simultaneous separate production from the central wellbore **900** and lateral wellbore **932**. Referring to **Figures 32C** and **32D**, optionally, the sand screen junction

component **920** could be replaced by solid expandable tubing thereby removing the need for string/sub-string **960**, tubing **937**, and the packer **965**.

[0079] In any of the configurations illustrated in **Figure 32**, the packer may be removed (replaced by just a pipe junction) utilizing the casing **902** for another production path.

[0080] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof. For example, the junction component could have added features to act as a bridging member to solids, sands, fluid, etc. to provide a natural seal. These may include swellable elastomers, epoxys, brushes, mesh materials, fibrous materials, foam, etc. Further, the junction component could be combined with the screen, disclosed in earlier embodiments, as a further barrier to solids, etc. Further, a cementing step may be added to the completion of the lateral wellbore. Also, the junction component may be carried in a retrievable deflector on the end of a liner shoe during any installation.

Claims:

1. A junction liner for use in a wellbore comprising:

a tubular body having at least three openings for fluid communication therethrough and at least one perforation in a wall thereof.

2. The junction liner of claim 1, whereby the body is multi-layered.

3. The junction liner of claim 1 or 2, further comprising a mating feature.

4. A wellbore junction apparatus for a junction between a central and a lateral wellbore comprising:

a first tubular portion comprising a first wall with a first aperture therein; and

a second tubular portion comprising a second wall and an end operatively connected to the first portion proximate the aperture, wherein at least one of the walls includes a perforation therethrough for filtering particulates.

5. The apparatus of claim 4, wherein the portions are multi-layered.

6. The apparatus of claim 4 or 5, further comprising a string of casing.

7. The apparatus of claim 4, 5 or 6, wherein the portions are joined to the junction with cement.

8. The apparatus of any of claims 4 to 7, wherein the second portion extends to the exterior of the first leg.

9. The apparatus of any of claims 4 to 8, wherein the second portion is extendable from the interior of the first portion.

10. The apparatus of any of claims 4 to 9, wherein the second portion comprises an expandable screen.

11. The apparatus of any of claims 4 to 10, wherein the first portion comprises an expandable screen.

12. The apparatus of any of claims 4 to 11, further comprising a string of casing and wherein the first portion is substantially located within the casing string.

13. The apparatus of claim 12, wherein the casing string includes an aperture in a wall thereof and the second tubular portion extends through the aperture.

14. The apparatus of any of claims 4 to 13, wherein the second portion is extendable from the interior of the first portion and is folded and contained within the first portion.

15. The apparatus of any of claims 4 to 14, further comprising a deflector with a cut-out portion substantially containing the folded second portion of the liner.

16. The apparatus of any claims 4 to 15, further comprising a tubular member with an end covered by the second portion.

17. The apparatus of claim 16, wherein the tubular member houses a drill bit and at least partially houses a drilling tubular.

18. The apparatus of any of claims 4 to 17, further comprising:

a deflector with a cut-out portion substantially containing the folded second portion;

an anchor attached to an upper end of the first portion; and

a run-in string with a reformer disposed through the anchor and at least partially through the first portion.

19. A system for completing a central wellbore and a lateral wellbore, comprising:

an at least partially expandable junction component located in a junction of the central and lateral wellbores;

a first expandable production string disposed within the lateral wellbore, coupled to the junction component;

a first packer located above the junction;

a second packer located below the junction in the central wellbore; and

a second production string running from a top surface of the central wellbore through the first packer to the second packer.

20. The system of claim 19, wherein the junction component comprises a particulate filtering portion.

21. The system of claim 19 or 20, further comprising: a sump pump disposed along the second production string between the two packers.

22. The system of claim 19, 20 or 21, further comprising: a sleeve valve disposed along the second production string between the two packers.

23. The system of any of claims 19 to 22, further comprising: a third production string coupled to the first packer and disposed within the first production string.

24. The system of claim 23, whereby the third string further extends through the first packer to the top surface of the central wellbore.

25. A method of excluding formation solids from a wellbore junction, comprising:

installing a junction liner having a flow path therethrough for a central wellbore and a flow path therethrough for a lateral wellbore; and

causing fluid adjacent the wellbore junction to enter the junction via perforations formed in at least one wall of the junction liner while filtering solid particles therefrom.

26. A method of supporting a wellbore junction, comprising:

at least partially forming at least one central wellbore and at least one lateral wellbore extending therefrom;

installing a junction liner having flow paths therethrough corresponding to the at least one central and the at least one lateral wellbore, the liner permitting fluid communication between at least one of the wellbores and the formation therearound; and

placing the walls of the junction liner in substantial contact with an intersection formed by the central and lateral wellbores.

27. The method of claim 26, wherein the substantial contact is made by expanding the junction liner in at least one location to increase the diameter thereof to correspond to the inner diameter of that location.

28. A method of forming a lateral wellbore from a central bore comprising:

placing a first tubular screen across a window in the central wellbore;

expanding the first screen against the walls of the central wellbore;

placing a second tubular screen through an aperture formed in a portion of the first screen extending across the window; and

expanding the second screen into substantial contact with the walls of the lateral wellbore.

29. A method of preparing a junction apparatus for installation in a junction between a central and an at least partially formed lateral wellbore, comprising:

providing the junction apparatus comprising:

a first tubular portion comprising a first wall with a first aperture therein; and

a second tubular portion comprising a second wall and an end operatively connected to the first portion proximate the aperture, wherein at least one of the walls includes a perforation therethrough for filtering particulates; and

folding the second portion so that it is substantially contained within the first portion.

30. The method claim 29, further comprising:

running the junction apparatus through the central wellbore to the junction; and

unfolding the second portion so that it extends into the at least partially formed lateral wellbore.

31. A method of supporting a junction between two intersecting wellbores, comprising:

milling a casing wall to form a window therein whereby the window is formed in the casing and a partial extension is formed in the earth outwards of the window;

inserting a tubular screen member into the window whereby a portion of the screen remains in the window and a portion extends outwards into the extension; and

causing the screen to substantially contact the walls of the window and walls of the extension.

32. A method of forming a lateral wellbore from a central bore comprising:

placing a central portion of a tubular screen across a window in the central wellbore;

expanding the central portion against the walls of the central wellbore;

placing a lateral portion of a tubular screen in the lateral wellbore; and

expanding the lateral portion into substantial contact with the walls of the lateral wellbore.

33. The method of claim 32, further comprising: cementing the screen into place inside the wellbore.

34. A method of forming a lateral wellbore comprising:

running an at least partially expandable, perforated junction component to the junction of a central and an at least partially formed lateral wellbore; and

expanding the junction component.

35. The method of claim 34, further comprising: forming the lateral wellbore junction from the central wellbore.

36. The method of claim 34 or 35, further comprising: providing a deflector device and an anchor in the central wellbore, whereby running includes guiding the at least partially expandable perforated junction component into the junction using the deflector device.

37. The method of claim 34, 35 or 36, further comprising: completing the lateral wellbore.

38. The method of any of claims 34 to 37, whereby the at least partially expandable, perforated junction component further comprises multiple layers.

39. The method of any of claims 34 to 38, further comprising: opening a central wellbore access port in the expandable perforated junction component.

40. The method of any of claims 34 to 39, whereby the at least partially expandable, perforated junction component further comprises a preformed central wellbore access port.

41. The method of any of claims 37 to 40, further comprising: completing the lateral wellbore;

running expandable production tubing into the lateral wellbore through the junction component; and

expanding the production tubing.

42. The method of any of claims 34 to 41, whereby the junction component further comprises a mating feature and placing further comprises locating and orienting the junction component in the junction using the mating feature.

43. The method of any of claims 34 to 42, wherein the at least partially formed lateral wellbore is a lateral wellbore and running an at least partially expandable perforated junction component further comprises running an at least partially expandable perforated junction component and a first string of expandable

production tubing, whereby the first string is run into the lateral wellbore and the junction component is run into a junction of the central and lateral wellbores; and

expanding the junction component and the production tubing.

44. The method of claim 43, further comprising: running a second string of production tubing from a top surface of the central wellbore into the central wellbore to a point near the junction, whereby the second string comprises a packer; isolating a lower end of the second string from the junction; and setting the packer at a location above the junction.

45. The method of claim 44, wherein the second string further comprises a sump pump.

46. The method of claim 44 or 45, wherein the second string further comprises a remotely operated sleeve valve.

47. The method of any of claims 43 to 46, further comprising: selectively producing from the central wellbore, the lateral wellbore, the junction, or any combination of the three.

48. A method of forming a lateral wellbore comprising:

placing a partially expandable junction component at the junction of a central and an at least partially formed lateral wellbore, whereby the component comprises a preformed central bore access port; and

expanding the junction component.

49. A method of forming a lateral wellbore comprising:

placing an expandable junction component at the junction of a central and an at least partially formed lateral wellbore;

expanding the junction component; and

opening a central wellbore access port in the junction component.

Application No: GB 0326054.4 **Examiner:** Alan Jones
Claims searched: 1-18, 25-27, 29 & 30 **Date of search:** 29 January 2004

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1-3, 25-27	GB 2357099 A	(BAKER HUGHES) See eg. abstract, fig 8 and page 5 lines 9-17
A		EP 0819823 A3	(HALLIBURTON)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[W]:

E1F

Worldwide search of patent documents classified in the following areas of the IPC[7]:

E21B

The following online and other databases have been used in the preparation of this search report :

Online: WPI, EPODOC, JAPIO